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LANDSAT 7 TO INTERNATIONAL GROUND STATION (IGS) INTERFACE CONTROL DOCUMENT

Revision F

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USGS
science for a changing world

LANDSAT 7 TO INTERNATIONAL GROUND STATION (IGS) INTERFACE CONTROL DOCUMENT

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Executive Summary

The International Ground Stations (IGSs) receive direct X-band downlink data from the Landsat 7 satellite. They interact with the satellite control center to schedule the downlinks and with the USGS archive to submit browse and metadata files. This Interface Control Document (ICD) establishes the hardware, software, data transfer, and operations interface requirements between the IGSs and the Landsat Project.

Keywords: international, station, IGS, schedule, contact, metadata, browse, transfer, priority, mask, IPM

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T H-1	TBD	Will Korea station interface directly with MOC and DAAC?	July 2003

Section 1 Introduction

1.1 Background

The International Ground Stations (IGSs) receive direct X-band downlink data from the Landsat 7 satellite. They interact with the satellite control center to schedule the downlinks and with the USGS archive to submit browse and metadata files.

1.2 Purpose and Scope

This Interface Control Document (ICD) establishes the Landsat 7 hardware, software, data transfer, and operations interface requirements between the International Ground Stations (IGS) and the Landsat Project.

Section 2 Document Organization

This document consists of 3 sections, 9 appendices, and a list of references:

- Section 1 describes the background of the interface, and the purpose and scope of this document.
- Section 2 explains the document organization.
- Section 3 contains the interface requirements between the IGS and the Landsat 7 system.
- Appendix A contains a glossary of terms and an acronym list.
- Appendix B defines the message formats.
- Appendix C contains the X-band communications link interface characteristics.
- Appendix D defines the metadata format.
- Appendix E defines the browse data format.
- Appendix F describes the mechanism for data transfer from the IGS to the DAAC.
- Appendix G describes the mechanism for data transfer between the MOC and the IGS.
- Appendix H lists the IGS stations and the type of interface with the MOC and DAAC.
- Appendix I describes the IGS Priority & Request Map Editor (IPM) online tool.
- A References list identifies documents related to this interface that might be of interest to the user.

Section 3 Requirements

3.1 Interface Descriptions

The interaction between the Landsat 7 system and the IGSs is shown in Figure 3-1. These interfaces are described in more detail in the following sections.

3.1.1 Mission Operations Center

The Mission Operations Center (MOC), staffed by the Flight Operations Team (FOT), is responsible for command and control of the Landsat 7 satellite and for scheduling of data acquisitions, and serves as the focal point for the IGS interface.

The MOC receives service requests from the IGSs, performs acquisition scheduling, and provides contact schedules to the IGSs.

The MOC makes orbit parameters available in three standard formats: North American Air Defense (NORAD) Two Line Elements, Brouwer Mean Elements (BMEs) and Improved Inter-Range Vectors (IIRVs). Each IGS indicates the format they are equipped to process.

Other messages are exchanged with the IGSs to document problems, identify station capabilities, and handle miscellaneous administrative matters.

The MOC sends the Calibration Parameter File to the IGSs when it is received from the Image Assessment System. This is expected to be quarterly.

3.1.2 Landsat 7 Satellite

The Landsat 7 satellite provides a 150 Mbps downlink to the IGSs via one of three X-band data frequencies. The data is composed of Enhanced Thematic Mapper Plus (ETM+) image data and Payload Correction Data (PCD) telemetry.

3.1.3 Earth Resources Observation System (EROS) Data Center

The EROS Data Center (EDC) houses the Land Processes Distributed Active Archive Center (LP DAAC), an element of the Earth Observing System (EOS) Data and Information System (EOSDIS). For Landsat 7, the DAAC archives Landsat 7 Level 0R data, metadata, and browse data. The DAAC supports user queries and distributes data to users. It maintains an online library of metadata and browse data for Landsat 7. The IGSs send metadata and browse data to the DAAC for inclusion in this library. The DAAC also maintains a library of calibration parameters and mission information for Landsat 7.

3.1.4 Mission Management Office

The Mission Management Office (MMO) is the top-level point of control for on-orbit Landsat 7 satellite and ground element operations. It acts on behalf of the Landsat Coordinating Group, which consists of the senior agency officials of the National Aeronautics and Space Administration (NASA) and the U.S. Geological Survey (USGS) who oversee the Landsat program. The MMO interacts with the IGSs for non-routine items such as Memorandum of Understanding (MOU) negotiations, policy decisions, and special service requests.

3.1.5 International Ground Stations

The International Ground Stations (IGSs) receive real-time Landsat 7 data and archive and process it for their own use. They send service requests to the MOC to schedule ETM+ data transmission to their stations and return metadata to the LP DAAC for data received and archived. The IGSs may also send browse data to the LP DAAC. They receive the Calibration Parameter File from the MOC.

3.1.6 Associated Elements

The following three elements are occasionally referenced in the ICD. They do not have a direct interface with the IGSs.

The Landsat Ground Station (LGS) is the data receive site located at EDC that receives the X-band data acquired for the U.S. and routes it to the processing facility. The X-band communications interface described in Appendix C applies to the LGS as well.

The Landsat 7 Processing System (LPS) is the image processing facility located at EDC that performs Level 0R processing on data acquired by the U.S. It generates metadata and browse data, which are archived at the LP DAAC.

The Image Analysis System (IAS) is the facility that monitors image quality and ETM+ sensor performance. It generates the Calibration Parameter File that is distributed to the IGSs by the MOC. The IAS also generates assessment reports on a regular basis. Anomalies that are identified during assessment are reported to the IGSs via the assessment reports and via Administrative Messages from the MOC if required.

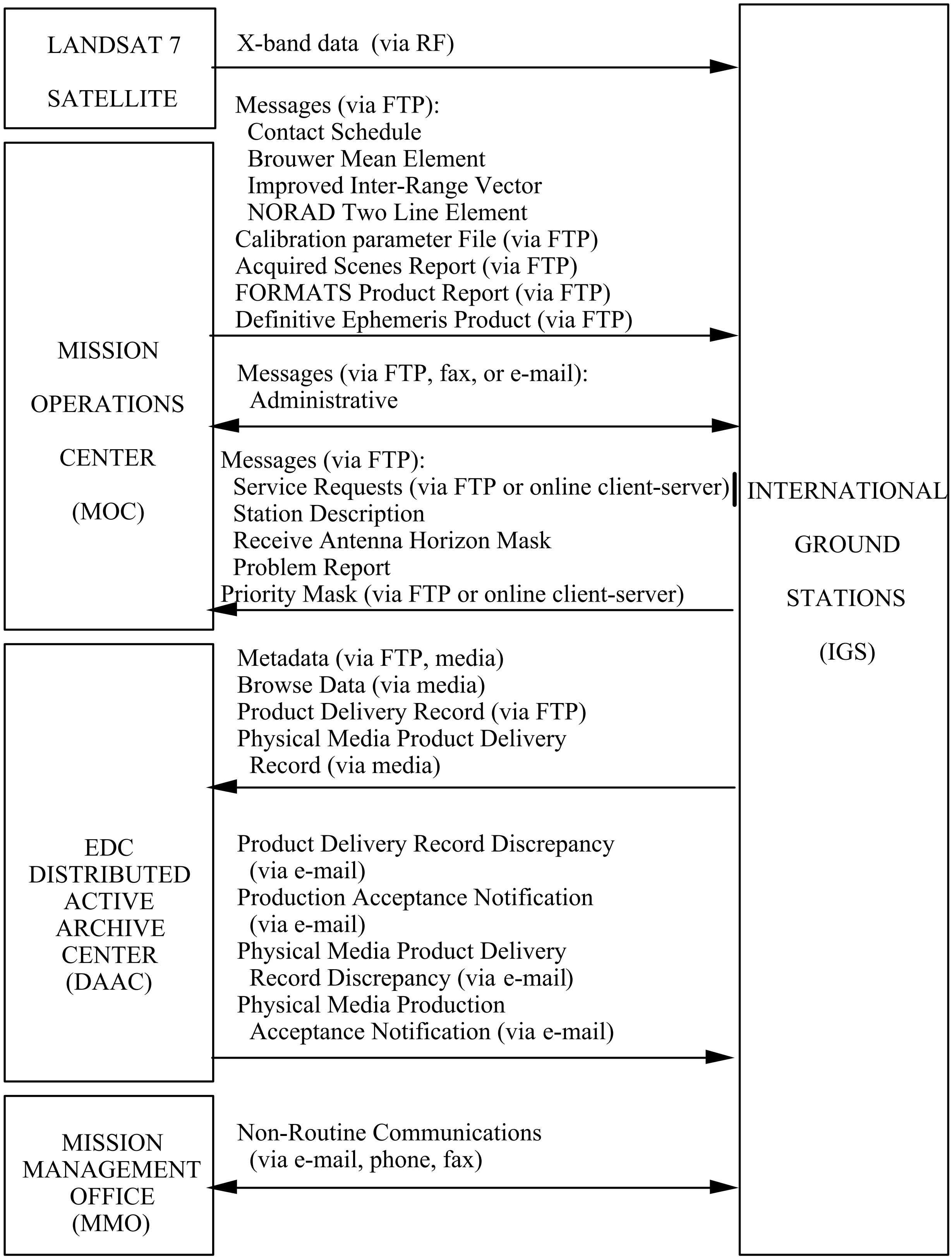


Figure 3-1 Interaction Between Landsat 7 System and the IGSs.

3.2 Data Transfer Messages

The following messages have been identified for this interface. For each message, a brief description is given of its source, destination, content and usage. Detailed formats are contained in Appendices B, F, and G. The file naming conventions for these messages is described at the end of this section.

3.2.1 Administrative

The Administrative (ADM) message is a free form message used to handle situations that are not covered by any other predefined message format. ADM messages sent to the MOC will be read and responded to by the MOC's Flight Operations Team personnel. Uses of this message now include: asking for the cancellation of a requested service; inquiring about a message sent for which no acknowledgment was received; notifying IGSs of spacecraft status changes, service request validation errors, impacts to imaging, or availability of a new Calibration Parameter File. Files being transmitted as ADM messages must conform to the file naming conventions specified in section 3.6.

3.2.2 Problem Report

The Problem Report (PRB) message is used by the IGSs to report potential satellite-related problems that may have occurred during scheduled transmissions of image data to a ground station. Sufficient information is provided to allow the MOC to analyze the problem and take whatever remedial actions are appropriate. The Problem Report message is sent as soon as possible but no later than 24 hours following a problem with an acquisition event.

3.2.3 Service Request

The Service Request is used by the IGSs to ask the MOC to schedule the transmission of data to a ground station. There are three methods for submitting Service Requests to the MOC:

1. The Service Request (REQ) message describes up to 10 swaths of data which Landsat 7 is to acquire and transmit to the requesting ground station one or more times. The Service Request message is validated by the MOC upon receipt. If an error is found, it is reported in the acknowledgment message (FORMATS Product Report) sent to the IGS for every file received.
2. A Request map is generated using the IGS Priority & Request Map Editor (IPM) online tool and submitted via the client server. The Request map is validated online and any errors found are reported to the IGS during the online session.
3. A Priority / Service Request Mask (PSR) file contains an array representing a block of scenes visible to the station, with requests indicated by a "1" in the appropriate array location and non-requested scenes indicated by a "0" in the array. The PSR file is validated by the MOC upon receipt. If an error is found, it is reported in the Manual Priority/Request Mask Submission Report sent to the IGS for every PSR file received.

An IGS can request any image data that can be transmitted from the satellite to itself in real-time. The request is stated in terms of the Landsat Worldwide Reference System (WRS). The Service Request must be received in the MOC at least 36 hours prior to the start of the requested acquisition.

3.2.4 Contact Schedule

The Contact Schedule (SCH) message is used by the MOC to notify a ground station of a scheduled X-band data transmission. It is sent to a ground station after every scheduling run that included a request from that ground station.

3.2.5 Station Description

The Station Description (DES) message is used by the IGSs to provide information needed for site to site communication. From time to time, as individual stations modify their equipment, capabilities, phone numbers, or data preferences, they are required to submit this message to the MOC, along with the effective date and time of the information. Note that the voice or FAX telephone numbers are used only as an emergency backup for the normal message distribution system unless specific agreements between the Landsat 7 Project and the IGSs are negotiated.

The DES message is sent once to establish the station baseline, and thereafter whenever the baseline changes. It must be sent at least 7 days prior to the effective date of change for any information.

3.2.6 Receive Antenna Horizon Mask

The Receive Antenna Horizon Mask (MSK) message is used by the IGSs to specify the minimum elevation angles at which the ground station has an unobstructed view of the Landsat 7 satellite. The MOC develops contact schedules using ground station to satellite access information. The access is based upon either IGS-provided elevation mask data or an access limit of five (5) degrees minimum local elevation angle as a default value for those stations that do not provide mask data.

The MSK message is sent once to establish the station profile, and thereafter whenever the profile changes. It must be sent at least 7 days prior to the effective date of change for any profile information.

3.2.7 Priority Mask

The Priority Mask is used by the IGSs to specify an acquisition priority of high, medium, or low for each scene of interest within their acquisition circle. This is used by the MOC scheduling system during scheduling of the IGS requests. There are three methods for submitting Priority Masks to the MOC:

1. The Priority Mask (PRI) message contains an array representing a block of scenes visible to the station, with priorities indicated by a 1, 2, or 3 in the appropriate array location.
2. A Priority map is generated using the IPM online tool and submitted via the client server. The Priority map is validated online and any errors found are reported to the IGS during the online session.
3. A Priority/Service Request Mask (PSR) file contains an array similar to the PRI message. Both the PRI message and the PSR file are validated by the MOC upon receipt. If an error is found, it is reported in the Manual Priority/Request Mask Submission Report sent to the IGS for every PRI or PSR file received.

The Priority Mask is submitted once to establish the station acquisition priorities, and thereafter whenever the priority profile changes. It must be submitted at least 2 days prior to the effective date of change for any priority.

3.2.8 Brouwer Mean Element

The Brouwer Mean Element (BME) message is used by the MOC to provide satellite orbit definition. It is sent daily.

3.2.9 Improved Inter-Range Vector

The Improved Inter-Range Vector (IRV) message is used by the MOC to provide satellite orbit definition. It is sent on Mondays / Wednesdays / Fridays only and after each orbital maneuver (usually done on Tuesdays).

3.2.10 NORAD Two Line Element

The NORAD Two Line Element (NOR) message is used by the MOC to provide satellite orbit definition. It is sent daily.

3.2.11 Acquired Scenes Report

The Acquired Scenes Report is generated by the MOC after completion of the daily scheduling run. It lists all the scenes that have been scheduled for acquisition by the IGS stations, with one report generated per station. Details on each scene are given, including times during which fill data will be downlinked.

The Acquired Scenes Report is sent to a ground station after every scheduling run that included a scheduled request from that ground station.

3.2.12 FORMATS Product Report

The Flight Dynamics Facility Orbit and Mission Aids Transformation System (FORMATS) software manages file transfers across the firewall between the open server and the closed servers in the MOC. The FORMATS Product Report is generated as an acknowledgment to the IGS that the file was received and successfully transferred into the MOC from the open server. In addition, it reports any errors found during validation of the Service Request (REQ) message.

The FORMATS Product Report is generated within 5 minutes of product ingest from the open server.

3.2.13 Manual Priority/Request Submission Report

A Manual Priority/Request Submission Report is generated in response to the ftp of a Priority/Service Request Mask (PSR) file to the MOC. It reports on the results of validation of the mask and is generated within 5 minutes of product ingest from the open server.

3.2.14 IPM Log

A log of all major activities on the IGS Priority & Service Request Editor (IPM) online tool is generated on an International Cooperator (IC) basis. It is placed in the reports directory on the MOC server.

3.2.15 Definitive Ephemeris Product

The Definitive Ephemeris Product (DEF) is provided to the IGSs for use in geometric correction processing of the image data. The product is generated daily after the completion of the day's orbit determination processing. It contains the position and velocity vectors, at one-minute timesteps, in the J2000 ECI coordinate system, and is based on the definitive ephemeris solution derived from the ground station tracking data.

The Definitive Ephemeris Product is sent daily.

3.2.16 Product Delivery Record (PDR) and Physical Media PDR

The Product Delivery Record (PDR) is used by the IGS to identify and describe each metadata file being electronically transferred to the DAAC. A Physical Media PDR is used by the IGS to identify and describe the metadata and browse data files being delivered to the DAAC on physical media.

A PDR or Physical Media PDR accompanies each delivery of data to the DAAC. Data deliveries are not processed until a corresponding PDR or Physical Media PDR is received.

3.2.17 PDR Discrepancy and Physical Media PDR Discrepancy

The PDR Discrepancy is used by the DAAC to report processing errors encountered during ingest of the PDR from the staging server. The Physical Media PDR Discrepancy is used by the DAAC to report processing errors encountered during ingest of the Physical Media PDR from the physical media.

These files are only sent when errors are found.

3.2.18 Production Acceptance Notification (PAN) and Physical Media PAN

The Production Acceptance Notification (PAN) is used by the DAAC to report the results of ingest and archival processing of the metadata placed on the staging server by the IGS. The Physical Media PAN is used by the DAAC to report the results of ingest and archival processing of the metadata and browse on physical media sent in by the IGS.

These files are always generated for each delivery.

3.3 X-Band Downlink Data

The Landsat 7 satellite has the capability to transmit one data stream to as many as three ground stations simultaneously. The satellite is capable of transmitting an X-band link to ground stations located on the horizon of the earth as viewed by the satellite. Each data stream contains sensor image data, sensor calibration data, and Payload Correction Data (PCD).
The downlink data is transmitted in accordance with the times and frequencies specified in the Contact Schedule message.

Appendix C contains the X-band communications link interface characteristics. Volume IV of the Landsat 7 Data Format Control Book (Reference Document 3) describes the X-band data format in detail.

3.4 IGS Metadata And Browse Data

The IGSs send metadata to the LP DAAC for all Landsat 7 data they receive and archive. Metadata is sent to the LP DAAC on at least a monthly basis. The IGSs also may send browse data to the DAAC.

The metadata provides information about each ETM+ scene acquired by the ground station. A partial list of the information contained in metadata is listed below:

- Geographic area coverage
- Date of image collection
- Station identification
- Sun elevation angle
- Summarization of non-nominal data
- Gain
- Data quality estimate
- Cloud cover assessment

Appendix D contains a detailed description of the metadata format.

The browse data provides a reduced volume representation of an image scene that can be viewed to determine general ground area coverage and spatial relationships between ground area coverage and cloud coverage.

Appendix E contains a detailed description of the browse data format.

3.5 Calibration Parameter File

The initial Calibration Parameter File (CPF) is provided by the MOC to the IGSs before launch. After launch, the MOC sends the Calibration Parameter File to the IGSs as updates are periodically made available by the Landsat 7 Image Assessment System. The data is also available at the LP DAAC. The nominal update frequency is every 90 days and is driven by the inclusion of 90 days of predictions for UT1-UTC correction parameters.

The Calibration Parameter File includes but is not limited to the following:

- Geometric parameters:
  - orbit parameters
  - scan mirror profile coefficients
  - time data rate, parameters and corrections
  - scan line corrector parameters
  - focal plane parameters
  - modulation transfer function
  - detector offsets and adjustments
  - spacecraft attitude bias
  - engineering coefficients
- Radiometric parameters:
  - gains
  - offsets
  - biases
  - scaling parameters

Refer to Volume V of the Landsat 7 Data Format Control Book (Reference Document 4) for a detailed description of the Calibration Parameter File.

3.6 File Naming Conventions

The file naming convention for all message files exchanged with the MOC is:

L7yyyydddxxxfff.Snn or .Vnn

where:
L7 = constant for Landsat 7
yyyy = 4-digit year of file creation
ddd = 3-digit day of year of file creation
xxx = 3-letter station id as defined in Table H-1
fff = 3-letter file type as defined in Table 3-1
.Snn = sequence number of the file type for this day of creation;
e.g., L71999333DKISCH.S01 is the second SCH file sent to DKI on day 333 in 1999
.Vnn = version number of the file type; used for DES and MSK file types
e.g., L71999333CUBDES.V03 is the fourth version of the Brazil station description to be issued for the mission (V00 is the first, pre-launch baseline version)

The file naming convention for the Acquired Scenes Report sent to the IGSs is:

L7yyyydddxxxACQ.Snn

where:
L7 = constant for Landsat 7
yyyy = 4-digit year of file creation
ddd = 3-digit day of year of file creation
xxx = 3-letter station id as defined in Table H-1
ACQ = 3-letter file type identifying this as the Acquired Scenes Report
.Snn = sequence number of the file type for this day of creation; e.g., L72000102FUIACQ.S01 is the second ACQ file sent to FUI on day 102 in 2000

The file naming convention for Calibration Parameters Files sent to the IGSs is:

L7CPFyyyymmdd_yyyymmdd.nn

where:
L7 = constant for Landsat 7
CPF = identifies this as a Calibration Parameter File
yyyy = 4-digit effectivity starting year
mm = 2-digit effectivity starting month
dd = 2-digit effectivity starting day
_ = separator
yyyy = 4-digit effectivity ending year
mm = 2-digit effectivity ending month
dd = 2-digit effectivity ending day
.nn = sequence number for this file; the 00 sequence number is a reserve sequence number uniquely identifying the pre-launch CPF; sequence numbers for subsequent 90-day time periods all begin with 01; sequence numbers for new versions or updates within the 90-day time period are incremented by one.

The file naming convention for the FORMATS Product report file sent to the IGS is:

[Original file name]xRPT

where:
[Original file name] = the name of the file that was transferred into the MOC and is being acknowledged, including the file extension
x = severity of the message:
I = informational, no errors are being reported
W = error(s) is(are) being reported but processing proceeded
E = error(s) is(are) being reported and processing stopped
RPT = constant, identifies this as a Report file

The file naming convention for the Manual Priority/Request Mask Submission Report is:

L7yyyydddxxxRPT.Snnrrrr

where:
- L7 = constant for Landsat 7
- yyyy = 4-digit year of file creation
- ddd = 3-digit day of year of file creation
- xxx = 3-letter station id as defined in Table H-1
- RPT = identifies this as a Manual Priority/Request Mask Submission Report
- .Snn = sequence number of the file type for this day of creation; e.g., .S01 is the second file sent to the station on that day
- rrrr = validation result:
  "PASS" for successful validation, (e.g., L72002125BJCRPT.S01PASS)
  "FAIL" for validation failure, (e.g., L72002125GNCRPT.S00FAIL)

The file naming convention for the IPM Log file sent to the IGS is:

IPM.log

The file naming convention for the Definitive Ephemeris Product report file sent to the IGS is:

L7yyyydddxxxDEF.Snn

where:
- L7 = constant for Landsat 7
- yyyy = 4-digit year of file creation
- ddd = 3-digit day of year of file creation
- xxx = 3-letter station id as defined in Table H-1
- DEF = identifies this as a Definitive Ephemeris Product file
- .Snn = sequence number of the file type for this day of creation; e.g., L72000045FUIDEF.S01 is the second DEF file sent to the FUI station on day 45 in 2000

The file naming convention for metadata files sent to the DAAC is:

L7xxxppprrryyyymmddf.MTA

where:
- L7 = constant for Landsat 7
- xxx = 3-letter station id as defined in Table H-1
- ppp = WRS Path of the first scene
- rrr = WRS Row of the first scene
- yyyy = 4-digit year of acquisition
- mm = month of acquisition
- dd = day of month of acquisition
- f = format included in the file: 0 = includes both formats 1 and 2
- .MTA = identifies this as a metadata file

The file naming convention for browse files sent to the DAAC is:

L7xxxppprrryyyymmdd.Rnn

where:
- L7 = constant for Landsat 7
- xxx = 3-letter station id as defined in Table H-1
- ppp = WRS Path
- rrr = WRS Row
- yyyy = 4-digit year of acquisition
- mm = month of acquisition
- dd = day of month of acquisition
- .Rnn = identifies this as a browse file
  where nn = sequence number of this scene in the original subinterval

The file naming convention for transfer management files exchanged with the DAAC is:

ORIGINATING_SYSTEM.yyyymmddhhmmss.ext

where:
- ORIGINATING_SYSTEM. = value of originating system provided in PDR (IGSxxx where xxx is 3-letter station id, as defined in Table H-1)
- yyyymmdd = date of file creation
- hhmmss = time of file creation
- .ext = file type:
  - .PDR = Product Delivery Record file
  - .PDRD = PDR Discrepancy file
  - .PAN = Production Acceptance Notification file
  - .PMPDR = Physical Media Product Delivery Record file
  - .PDRD = Physical Media PDR Discrepancy file
  - .PAN = Physical Media Production Acceptance Notification file

The file names are listed in Table 3-1. The three-letter station designation is always in the file name (the one exception to this statement is the Calibration Parameters File), and identifies the station sending a file to the MOC/DAAC or receiving a file from the MOC/DAAC. Table H-1 lists the IGS site three-letter designations and identifies which is used for communication with the MOC, and for communication with the DAAC. The table is sorted by Country and Location. The station description message will identify the appropriate e-mail and Internet IP addresses for MOC/DAAC message and file exchange.

TYPE	DESCRIPTION	FULL FILE NAME *
ADM	Administrative	L7yyyydddxxxADM.Snn
PRB	Problem Report	L7yyyydddxxxPRB.Snn
REQ	Service Request	L7yyyydddxxxREQ.Snn
SCH	Contact Schedule	L7yyyydddxxxSCH.Snn
DES	Station Description	L7yyyydddxxxDES.Vnn
MSK	Receive Antenna Horizon Mask	L7yyyydddxxxMSK.Vnn
PRI	Priority Mask	L7yyyydddxxxPRI.Snn
BME	Brouwer Mean Element	L7yyyydddxxxBME.Snn
IRV	Improved Inter-Range Vector	L7yyyydddxxxIRV.Snn
NOR	NORAD Two Line Element	L7yyyydddxxxNOR.Snn
ACQ	Acquired Scenes Report	L7yyyydddxxxACQ.Snn
PSR	Priority/Service Request Mask file	L7yyyydddxxxPSR.Snn
CPF	Calibration Parameter File	L7CPFyyyymmdd_yyyymmdd.nn
—	FORMATS Product Report	[Original file name]xRPT
—	Manual Priority/Request Submission Report	L7yyyydddxxxRPT.Snnrrrr
—	IPM Log	IPM.log
DEF	Definitive Ephemeris Product	L7yyyydddxxxDEF.Snn
—	Metadata File	L7xxxppprrryyyymmddf.MTA
—	Browse Data File	L7xxxppprrryyyymmdd.Rnn
—	Product Delivery Record File	IGSxxx.yyyymmddhhmmss.PDR
—	PDR Discrepancy File	IGSxxx.yyyymmddhhmmss.PDRD
—	Production Acceptance Notification File	IGSxxx.yyyymmddhhmmss.PAN
—	Physical Media Product Delivery Record File	IGSxxx.yyyymmddhhmmss.PMPDR
—	Physical Media PDR Discrepancy File	IGSxxx.yyyymmddhhmmss.PDRD
—	Physical Media Production Acceptance Notification File	IGSxxx.yyyymmddhhmmss.PAN

* xxx is the three-character station designation as defined in Table H-1

FORMATS Product Report, Manual Priority/Request Submission Report, IPM Log file names are fully defined in Appendix G

Metadata and browse file names are fully defined in Appendices D and E

PDR, PDR Discrepancy, PAN, Physical Media PDR, Physical Media PDR Discrepancy, Physical Media PAN file names are fully defined in Appendix F

Table 3-1 File Types and Names.

3.7 Communications Architecture

There are six modes of communication used for the IGS interface:

1. Electronic transfer (FTP "put" and "get")
2. Physical media transfer
3. Electronic mail (e-mail)
4. Fax
5. Telephone
6. Client server (online)

3.7.1 Electronic Transfer (FTP "put" and "get")

Electronic transfer applies to the IGS interface with both the MOC and DAAC. In each case of electronic transfer, there is a firewall that protects the MOC and DAAC from access by outside elements. On the open side of the firewall is a server that is accessible by the IGSs and on which incoming files are placed by the IGSs. On the closed side of the firewall is software that polls the server on the open side and transfers files from the open side to a server on the closed side. The files are then processed as appropriate.

Figure 3-2 shows the communications architecture for electronic file transfer between the MOC and the IGSs. The specifics for IGS electronic file exchange with the MOC are described in detail in Appendix G.

Figure 3-3 shows the communications architecture for electronic file transfer between the DAAC and the IGSs. The specifics for IGS electronic file exchange with the DAAC are described in detail in Appendix F.

Frequency of polling, account names, password management, and directory/file cleanup for both the MOC and DAAC server interfaces are addressed in detail in the Operations Agreement (Reference Document 7).

3.7.2 Physical Media Transfer

This is applicable only to the IGS interface with the DAAC. Figure 3-4 shows the architecture for physical media transfer to the DAAC. The specifics for IGS physical media transfer to the DAAC are described in detail in Appendix F.

3.7.3 Electronic Mail (e-mail)

Some administrative messages (ADM) may be sent to the IGSs via electronic mail (e-mail) as well as via electronic transfer if they are of a time-critical or urgent nature. All messages from the DAAC to the IGSs are via e-mail.

3.7.4 Fax

This is used primarily for non-routine communications with the Mission Management Office. It may also be used for emergency communications with the MOC, and to resubmit a PMPDR to the DAAC that was found to be missing or unreadable.

3.7.5 Telephone

This is used primarily for non-routine communications with the Mission Management Office. It may also be used for emergency communications with the MOC.

3.7.6 Client Server (Online)

The IGS Priority & Request Map Editor (IPM) online tool is hosted on a client server and allows the IGSs to submit priority and request maps over the Internet. The IPM tool is further defined in Appendix I and in Reference Document 13.

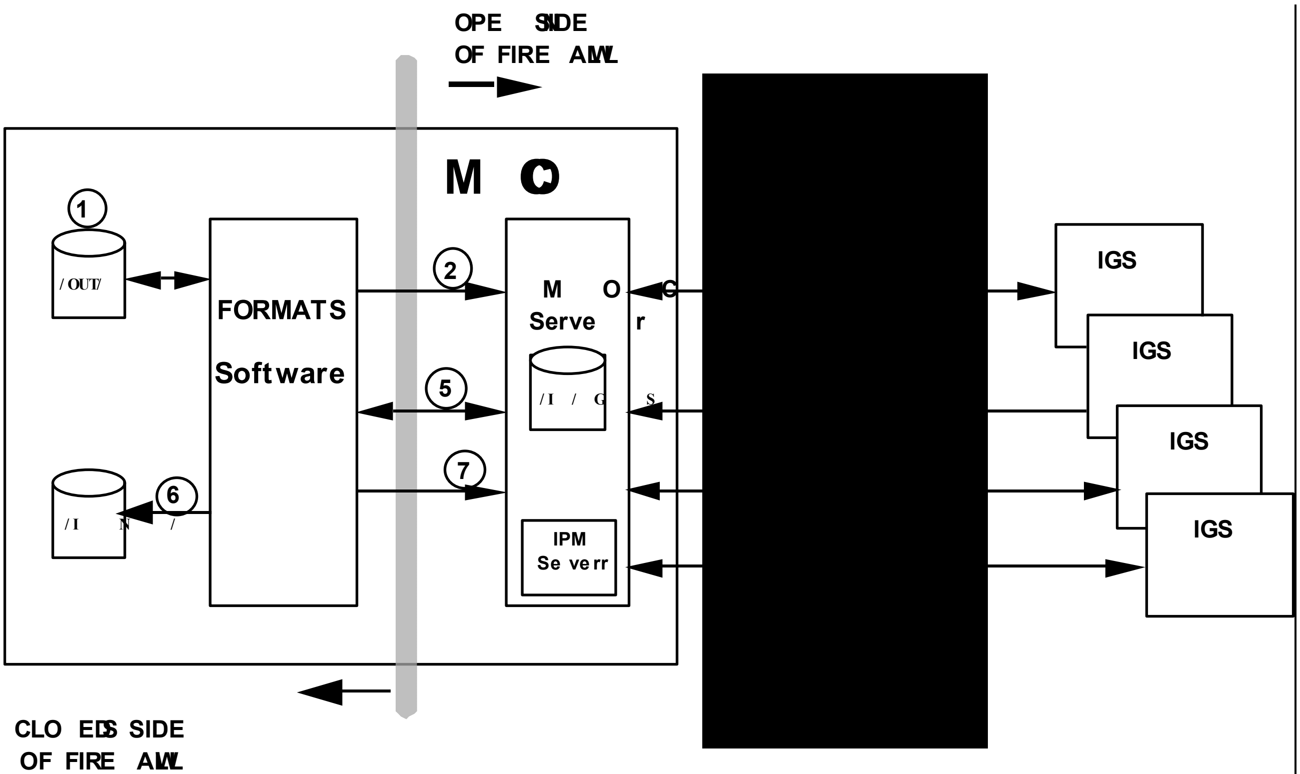
3.8 Security Policy

Electronic access to the Landsat 7 servers that are used for the IGS interfaces will be granted as long as the following conditions are met:

1. The station has signed an MOU with the USGS for access to Landsat 7 data.
2. The station is currently active or is within 3 months of being active.

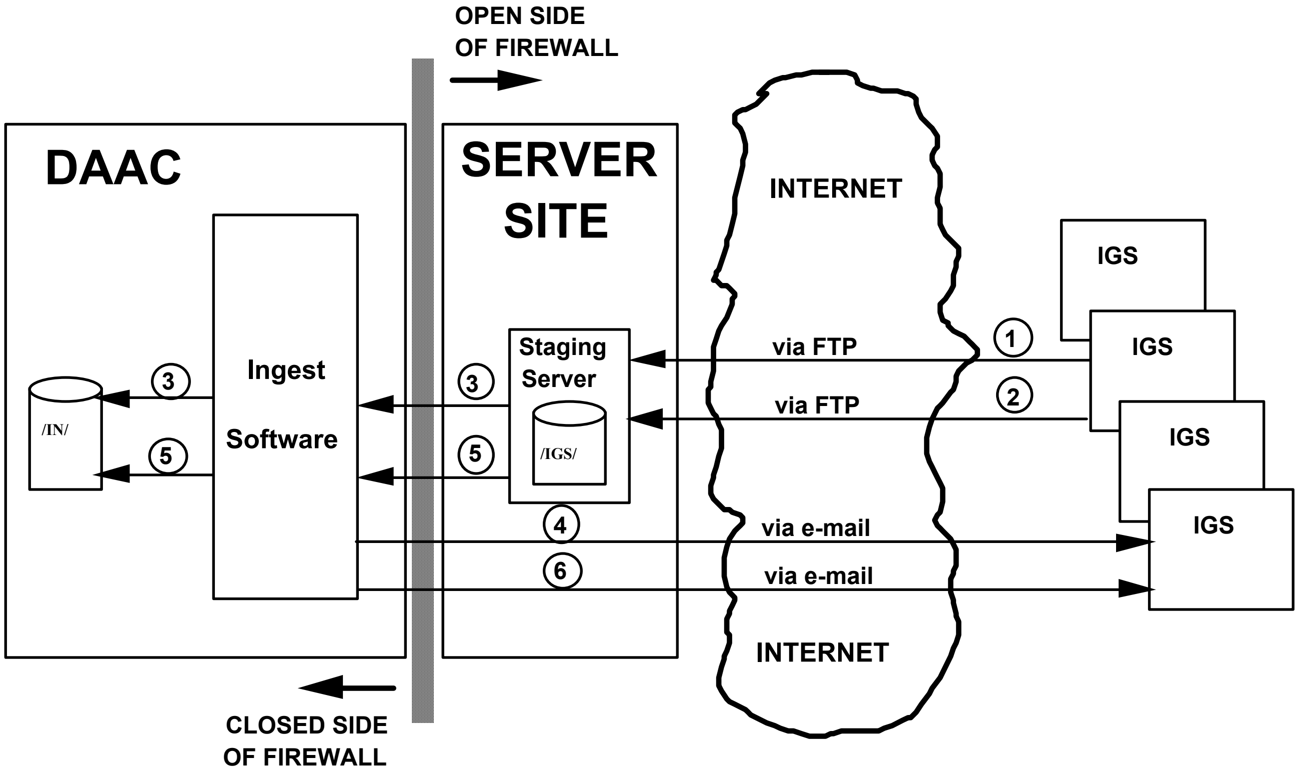
In the MOC, this applies to access to the MOC server (for sending/retrieving messages and reports) and to the IPM online tool. When the above conditions are met, the station will be provided with account, password, and IP address information.

In the DAAC, this applies to access to the DAAC server (for sending metadata). When the above conditions are met, the station will be provided with account and IP address information.



1. Files (m ssaeges) to be sent fro thme M Oto thCe IGSs are place idn M O C output direc oriets for pickup by FOR ATMS .
2. FOR ATMS polls the M Cout putOt direc oriets for IGS files and places the mon the open se ver in the app opriate IGS output direc ort y .
3. The IGSs poll the open se ver and "g t"e files via FTP.
4. Files to be sent fro thme IGSs to the M Oare Cp t"u on the open se ver in the app opriate IGS input direc ort y .
5. FOR ATMS polls the open se ver and "ge "s t files via FTP.
6. Files are valid tea dand transf rre e to dthe app opriate M Ose vGer .
7. FOR ATMS ge erat s ePr duot cRep rt o as acknowledg emnt of files rec ive d fro thme IGS and transf rre e intd the M C Oor, to rep rt oerr rso found during valid tion of the Servic Request m ssaeg . e
8. The IGS uses the IPM online tool to ge erat ethe priorit ymap or req estu map and submit these to the M Ovia Ga clie t-sev ver int e fa re.c

Figure 3-2 MOC Communications Architecture and Message Flow.



1. Metadata file(s) are sent to the staging server from the IGS via FTP and "put" in the /DATA directory.

2. The associated Product Delivery Record file is then sent to the staging server from the IGS via FTP, and "put" in the /PDR directory.

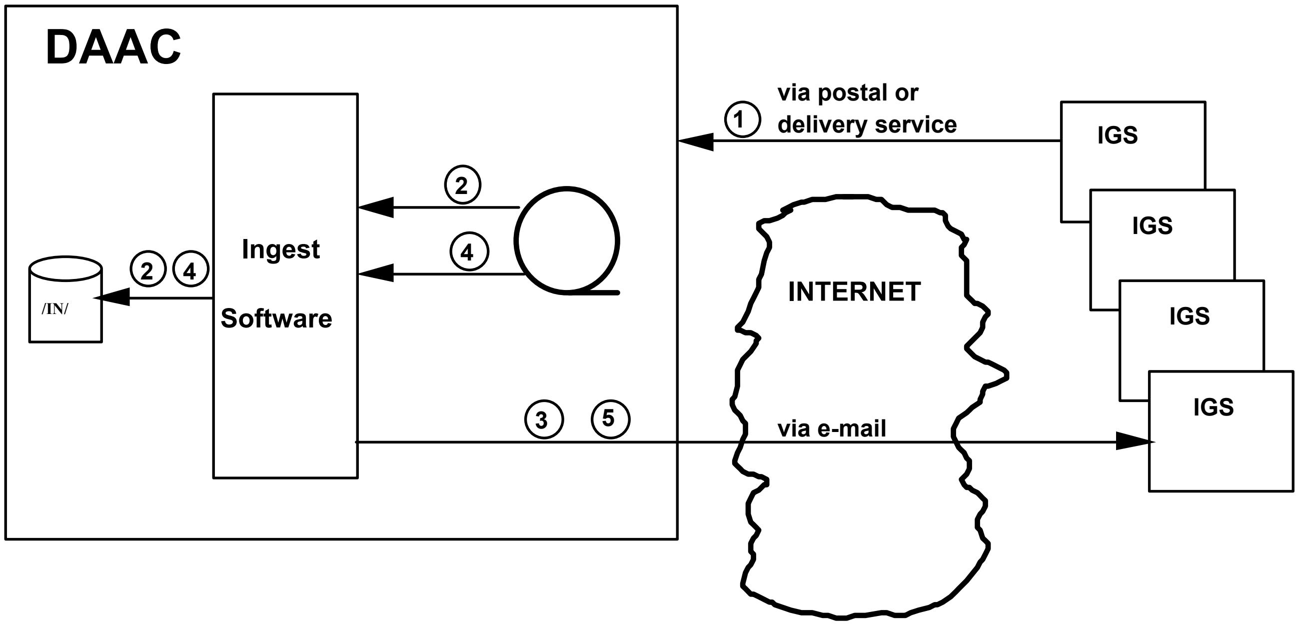
3. The Product Delivery Record is processed first.

4. If errors are found in the Product Delivery Record, they are reported in the Product Delivery Record Discrepancy file which is sent via e-mail to the IGS.

5. After no errors are found in the Product Delivery Record, metadata is ingested and processed.

6. Results of metadata processing are reported in the Production Acceptance Notification file which is sent to the IGS via e-mail.

Figure 3-3 DAAC Communications Architecture and Data Flow for Electronic Transfer.



1. Metadata file(s), browse files, and associated Physical Media Product Delivery Record file are sent to the DAAC from the IGS on physical media via postal or delivery service.

2. The Physical Media Product Delivery Record is processed first.

3. If errors are found in the Physical Media Product Delivery Record, they are reported in the Physical Media PDR Discrepancy file which is sent via e-mail to the IGS.

4. After no errors are found in the Physical Media Product Delivery Record, metadata and browse data are ingested and processed.

5. Results of metadata and browse data processing are reported in the Physical Media Production Acceptance Notification file which is sent to the IGS via e-mail.

Figure 3-4   DAAC Architecture and Data Flow for Physical Media Transfer.

Appendix A Glossary And Acronym List

A.1 Glossary Of Terms

Browse data	A reduced data volume representation of an image scene that can be viewed to determine general ground area coverage and spatial relationships between ground area coverage and cloud coverage. Browse data typically consists of three spectral bands.
ETM+ Format 1	The ETM+ Format 1 major frames contain all data (e.g., imaging and calibration) from and associated with Bands 1–6. The Mirror Scan Correction Data and Payload Correction Data are duplicated in both ETM+ formats.
ETM+ Format 2	The ETM+ Format 2 major frames contain all data (e.g., imaging and calibration) from and associated with Bands 6–8. The Mirror Scan Correction Data and Payload Correction Data are duplicated in both ETM+ formats.
Full Scene	A full WRS scene with overlap is defined to be 375 ETM+ scans. A nominal scene without overlap is defined to be 335 ETM+ scans. Due to a redesign of the scan mirror bumpers which resulted in a larger turnaround interval and an increase in the nominal number of minor frames per major frame from 7,423 to 7,473, the nominal size of a scene without overlap may decrease. Further bumper wear changes may further decrease the number of scans without overlap. The number of overlap scans will increase to compensate for the decrease in the non-overlap scene size.
Interval	The time duration between the start and end of an imaging operation (land observation) by the ETM+ instrument on board the Landsat 7 spacecraft. The raw wideband data collected during an interval consists of a contiguous set of WRS scenes. An interval may be from one to 35 full scenes in length.
Level 0R product	A US data product in which the data has been spatially reformatted but the data values remain unchanged. No radiometric or geometric corrections have been performed on the data. The reformatting is fully reversible. The data is band sequential. Attached to the image data are radiometric calibration image data, payload correction data, quality data, and metadata.
Metadata	A set of descriptive information about the scene data contained in the archive. The information is sufficient for a user, during the process of scene query and selection, to determine at a minimum geographic coverage, date of collection, sensor gain mode, time of acquisition, cloud cover, and other quality measurements.

Partial Scene — A partial scene (less than 375 scans) may exist at the beginning or end of a subinterval due to the fact that imaging events do not always start or end on WRS scene boundaries. If generated, browse and scene metadata for these occurrences accurately reflect their partial scene nature and geographic extent.

Payload Correction Data (PCD) — Imaging support data imbedded in the wideband data stream. Includes satellite attitude, ephemeris, time, angular displacement sensor (ADS) data, and payload state.

Scene Corners - Upper — As processed by the LPS, the upper corners of a scene are the corners associated with the trailing edge (first scan) of a scene. For descending path scenes, the upper left corner corresponds to the north-west corner of a scene and the upper right corner corresponds to the north-east corner of a scene. For ascending path scenes, the upper left corner corresponds to the south-east corner of a scene and the upper right corner corresponds to the south-west corner of a scene. These mappings hold for the band file geolocation fields and the metadata file. See Figure A-1 for the context of the corners with respect to the spacecraft and the image display.

Scene Corners - Lower — As processed by the LPS, the lower corners of a scene are the corners associated with the leading edge (last scan) of a scene. For descending path scenes, the lower left corner corresponds to the south-west corner of a scene and the lower right corner corresponds to the south-east corner of a scene. For ascending path scenes, the lower left corner corresponds to the north-east corner of a scene and the lower right corner corresponds to the north-west corner of a scene. These mappings hold for the band file geolocation fields and the metadata file. See Figure A-1 for the context of the corners with respect to the spacecraft and the image display.

Site — The physical location of an International Ground Station (IGS) or the Mission Operations Center (MOC).

Subinterval — A contiguous segment of a raw wideband data interval received during a Landsat 7 contact period. Subintervals are caused by breaks in the wideband data stream due to communication dropouts and/or the inability of the spacecraft to transmit a complete observation (interval) within a single Landsat 7 contact period. The largest possible subinterval can be as long as a full imaging interval (a set of contiguous WRS scenes) transmitted during an uninterrupted contact period. The smallest possible subinterval can be as small as a single partial WRS scene.

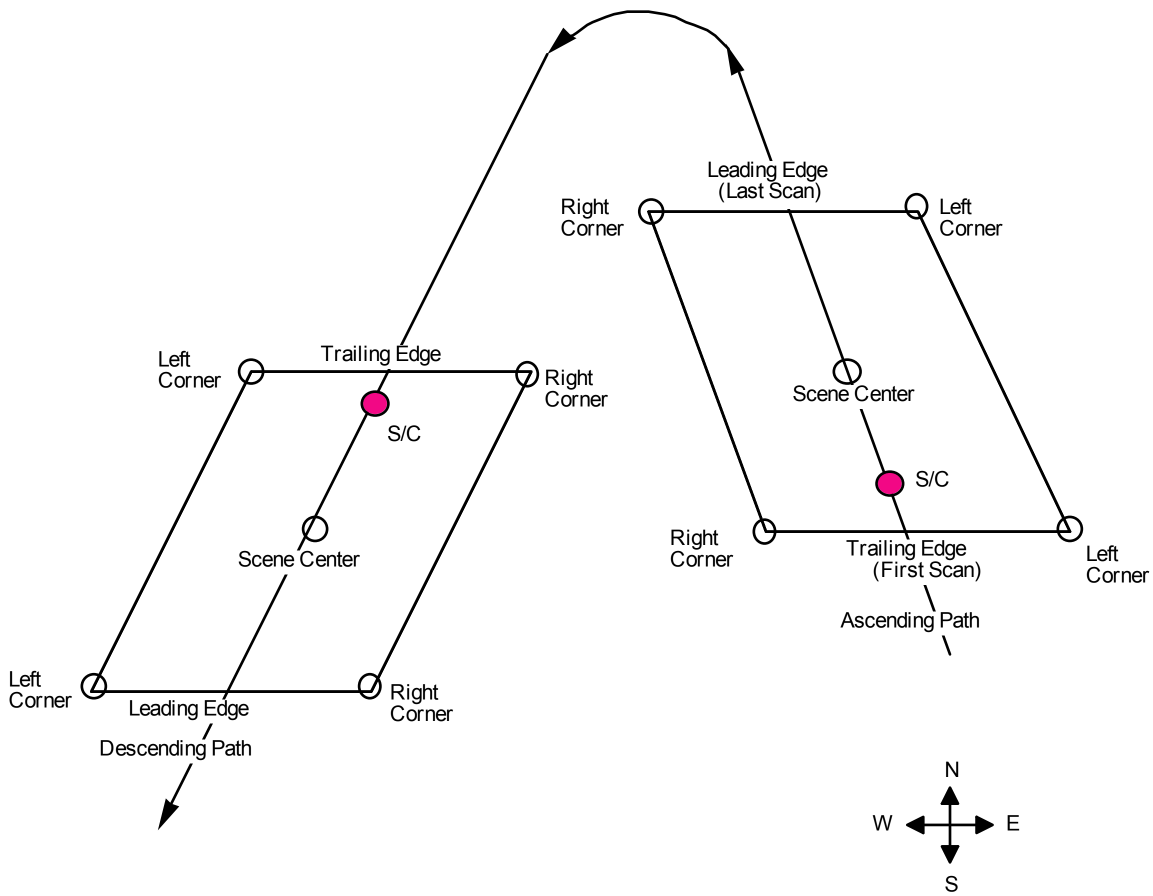
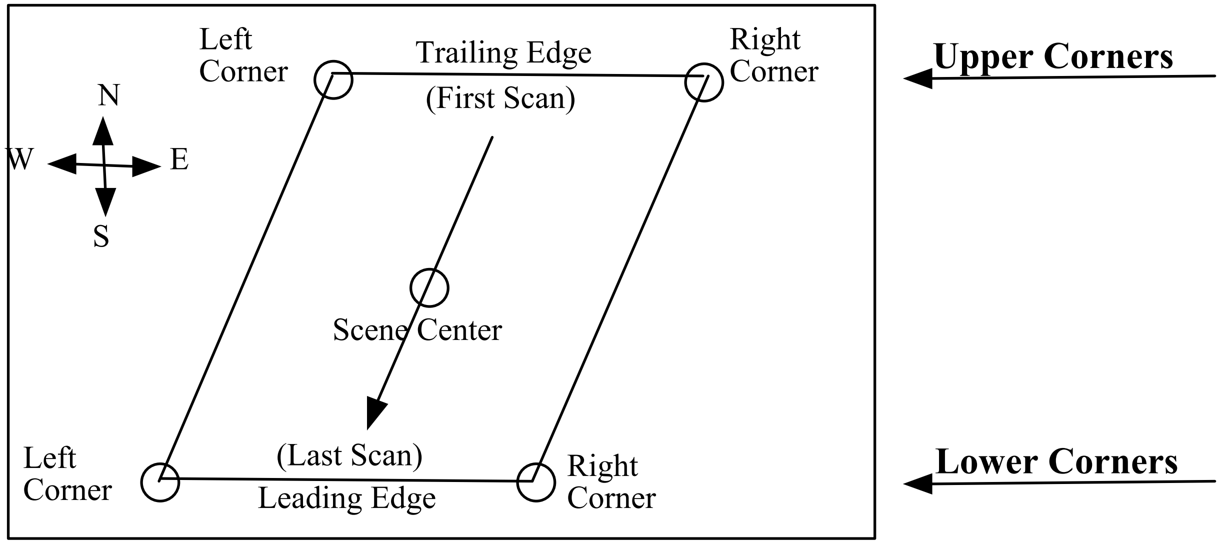
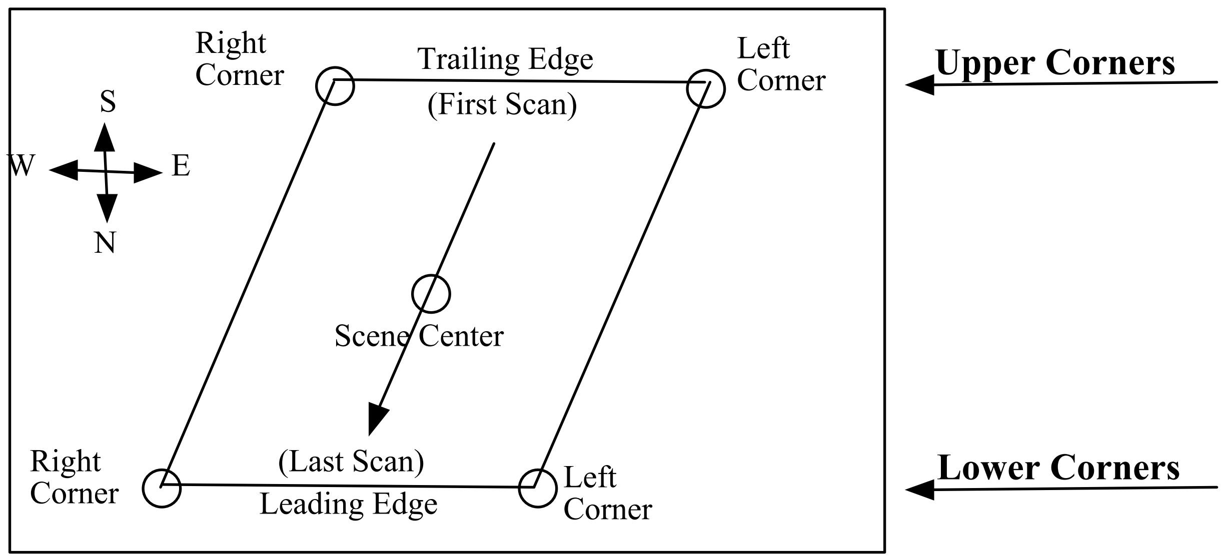


Figure A-1 WRS Scene Corners Context. (1 of 2)



Descending Path - Image Display



Ascending Path - Image Display

Figure A-1 WRS Scene Corners Context. (2 of 2)

A.2 Acronym List

ACCA	Automated Cloud Cover Assessment
ACQ	Acquired Scenes Report
ACQ., Acq.	Acquisition
ADM	Administrative message
ADS	Angular Displacement Sensor
ANSI	American National Standards Institute
AOS	Acquisition Of Signal
API	Application Programming Interface
AQPSK	Asynchronous Quadrature Phase Shift Keying
AR	Axial Ratio
ARG.	Argument
ASCEND.	Ascending
ASCII	American Standard Code for Information Interchange
BCH	Bose–Chaudhuri–Hocquenghem error detection and correction
BER	Bit Error Rate
BME	Brouwer Mean Element
BPSK	Biphase Shift Key
BSTAR	Drag-related parameter in the NORAD two-line element message
BSU	Baseband Switching Unit
C	Centigrade
C	Programming language
CA	California
CADU	Channel Access Data Unit
CC	Cloud Cover
CCA	Cloud Cover Assessment
CCSDS	Consultative Committee for Space Data Systems
CPF	Calibration Parameter File
D	Day
DAAC	Distributed Active Archive Center
DB	Data Block
dB	Decibel

dB-Hz	Decibel-Hertz
dB/K	Decibel per Degree Kelvin
dBi	Decibel above isotropic
dBW	Decibel Relative to 1 Watt
DC	District of Columbia
DCN	Document Change Notice
DD	Data Descriptor
DEF	Definitive Ephemeris Product
DEG., deg	Degree
DES	Station Description message
descr.	Description
DFCB	Data Format Control Book
DLR	German Space Agency
DR	Delivery Record
DTG	Date Time Group
e-mail	Electronic mail
E_b	Energy per bit
ECI	Earth Centered Inertial
ECS	EOSDIS Core System
EDAC	Error Detection And Correction
EDC	EROS Data Center
EH	ETM+ Header data
EIRP	Effective Isotropic Radiated Power
EOC	Earth Observation Center
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
EROS	Earth Resources Observation System
ESDIS	Earth Sciences Data and Information System
ESRIN	European Space Research Institute
ET	ETM+ Trailer data
ETM+	Enhanced Thematic Mapper Plus

FAX	Facsimile Transmission
FL	Full scene
fmt	format
FORMATS	Flight Dynamics Facility Orbit and Mission Aids Transformation System
FOT	Flight Operations Team
FREQ.	Frequency
FTP, ftp	File Transfer Protocol
G/T	Gain over Temperature
GAQD	Originator routing code for IIRV messages
GAR	Global Archive Refresh
GB	GigaByte
GEOC.	Geocentric
GMT	Greenwich Mean Time
GP4	General perturbations theory
GRPS	Groups
GSFC	Goddard Space Flight Center
GXA	Gimbaled X-Band Antenna
HDF	Hierarchical Data Format
Hex	Hexadecimal
HR.	Hour
HT.	Height
HTSI	Honeywell Technology Solutions Inc.
Hz	Hertz
I	In-Phase channel
I/O	Input/Output
IAS	Image Assessment System
IC	International Cooperator
ICD	Interface Control Document
ID	Identification
IGS	International Ground Station

IIRV	Improved Inter-Range Vector
IP	Internet Protocol
IPM	IGS Priority & Request Map Editor online tool
IRV	Improved Inter-Range Vector message
ISO	International Standards Organization
JFIF	JPEG File Interchange Format
JPEG	Joint Photographic Experts Group
JPL	Jet Propulsion Laboratory
K	Degrees Kelvin
KB	Kilobyte
kHz	Kilohertz
Km, KM.	Kilometer
L7	Landsat 7
LAT, LAT.	Latitude
LGS	Landsat 7 Ground Station
LL	Lower Left
LON, long.	Longitude
LOS	Loss Of Signal
LP	Land Processes
LPS	Landsat 7 Processing System
LR	Lower Right
LS7	Landsat 7
LTAP	Long Term Acquisition Plan
M	Minute
M	Month
M2	Mid Frequency #2
MAX.	Maximum
MB	Megabyte
Mbps	Mega bits–per–second
MD	Maryland
MHz	MegaHertz

MIN., min	Minutes
mm	Millimeter
mm/hr	Millimeters per Hour
MMO	Mission Management Office
MOC	Mission Operations Center
MOU	Memorandum of Understanding
MSK	Receive Antenna Horizon Mask message
MTA	Metadata
N/A	Not Applicable
N_0	Noise Density
NASA	National Aeronautics and Space Administration
NCSA	National Center for Supercomputing Applications
NO, NO.	Number
NOR	NORAD Two Line Element Message
NORAD	North American Air Defense
NRZ-L	Non Return to Zero–Level
OA	Operations Agreement
ODL	Object Description Language
PAN	Production Acceptance Notification
PCD	Payload Correction Data
PDR	Product Delivery Record
PDRD	Product Delivery Record Discrepancy
PL–DRO	Phase Locked Dielectric Resonance Oscillator
PN	Pseudorandom Noise
PRB	Problem Report message
PRI	Priority Mask message
PSR	Priority/Service Request Mask file
PVL	Parameter Value Language
Q	Quadrature channel
QUAD	Quadrant
QPSK	Quadrature Phase Shift Keying

R.A.	Right Ascension
REQ	Service Request message
REQ.	Request
RF	Radio Frequency
RGB	Red, Green, Blue
RHC	Right-hand Circular
RIS24	24-bit Raster Image
RT	Realtime
S	Seconds
S/C	Spacecraft
SAIC	Science Applications International Corporation
SCH	Contact Schedule message
SD	South Dakota
SDS	Scientific Data Set
SEC., sec	Seconds
SL	Scan Line
SSPA	Solid State Power Amplifier
STA	Station
SW	Switch
T	Temperature
tar	Tape Archiver
TBD	To Be Determined
TBR	To Be Resolved
TBS	To Be Supplied
TCP/IP	Transmission Control Protocol/Internet Protocol
UL	Upper Left
UR	Upper Right
URL	Uniform Resource Locator
US, U.S.	United States
USGS	United States Geological Survey
UT	Universal Time

UTC	Coordinated Universal TIme
VCID	Virtual Channel Identifier
VCDU	Virtual Channel Data Unit
VEL.	Velocity
WRS	Worldwide Reference System
Y	Year
Z	Zulu time

Appendix B Message Formats

For messages in sections B.1-B.6:

- All message lines are formatted as KEYWORD : VALUE
- All message lines (KEYWORD:VALUE) end with an ASCII carriage return followed by an ASCII line feed, unless otherwise noted. The carriage return and line feed must be after the full KEYWORD:VALUE phrase.
- All messages are written in the English language.

B.1 Administrative Message

The Administrative (ADM) message contains four (4) keywords. Figure B-1 shows the format and description of the Administrative message.

```
TYPE:          ADM
DTG:           2000/039:19:25:00
TEXT:          Landsat 7 will resume ETM+ downlinks at the beginning of Day
               040.

               Thank you,
               Michele Reeley
TEXTEND:
```

KEYWORD	VALUE	DESCRIPTION
TYPE:	ADM	Identifies this as an Administrative message
DTG:	yyyy/ddd:hh:mm:ss where yyyy = 1997 - 2100 (year) ddd = 001 - 366 (day of year) hh = 00 - 23 (hours) mm = 00 - 59 (minutes) ss = 00 - 59 (seconds)	Date-Time Group; identifies the date and time of creation of the message
TEXT:	free-form text; ASCII line feeds may be used to enhance readability; last two characters of this field must be carriage return and line feed	One or more sentences.
TEXTEND:		Indicates the end of the message

Figure B-1 Administrative Message Format.

B.2 Problem Report Message

The Problem Report (PRB) message contains six (6) keywords. Figure B-2 shows the format and description of the Problem Report message.

If there is more than one problem to report, the station may repeat these three keywords (SCHEDULED EVENT, OBSERVATION, COMMENTS) for each subsequent problem to be reported. The TEXTEND keyword should be the last keyword of the message.

```
TYPE:              PRB
DTG:               2000/048:13:38:31
SCHEDULED EVENT:   7 2000-02-17:12:37:45 12:37:51 2000-02-17:12:39:25
                   12:39:26 XM 1
OBSERVATION:       Other – See Comments
COMMENTS:          only white pixels in the whole track, acquisition ok.
TEXTEND:
```

KEYWORD	VALUE	DESCRIPTION
TYPE:	PRB	Identifies this as a Problem Report message
DTG:	yyyy/ddd:hh:mm:ss where yyyy = 1997 - 2100 (year) ddd = 001 - 366 (day of year) hh = 00 - 23 (hours) mm = 00 - 59 (minutes) ss = 00 - 59 (seconds)	Identifies the date and time of creation of the message
SCHEDULED EVENT:	7 fields as defined below, separated by ASCII space	Exact copy of the SCHEDULED EVENT line from the appropriate Contact Schedule message
	7	Source of the data (Landsat 7)
	yyyy-mm-dd:hh:mm:ss where: yyyy = 1997 - 2100 (year) mm = 01 - 12 (month) dd = 01 - 31 (day) hh = 00 - 23 (hour) mm = 00 - 59 (minute) ss = 00 - 59 (second)	GMT date and time that the satellite transmitter was to be turned on (AOS)
	hh:mm:ss (same as above)	GMT time that the first data block was to be received
	yyyy-mm-dd:hh:mm:ss (same as above)	GMT date and time that the last data block was to be received

Figure B-2 Problem Report Message Format. (1 of 2)

KEYWORD	VALUE	DESCRIPTION
	hh:mm:ss (same as above)	GMT time that the satellite transmitter was to be turned off (LOS)
	xx = XL (low freq., 8082.5 MHz) = XM (mid freq., 8212.5 MHz) = XH (high freq., 8342.5 MHz)	Carrier frequency that was to be used
	x = 1, 2 or 3	Satellite antenna that was to be used
OBSERVATION:	10 to 20 characters, see Table B-1 for the pre-defined values	Basic observation of the ground station during the event
COMMENTS:	free-form text, any length; line feeds may be used to enhance readability; last two characters of this field must be carriage return and line feed	Additional comments which relate to the specific event; should include frequencies on which reception was attempted and any other information which would help in problem analysis
TEXTEND:		Indicates the end of the message

Figure B-2 Problem Report Message Format. (2 of 2)

OBSERVATION VALUE	DEFINITION
NO CARRIER	The satellite X-band carrier was not received.
NOISY SIGNAL	The satellite X-band signal was too noisy to record and process.
STATION DOWN	The station was unable to operate during the scheduled event.
SEVERE WEATHER	Severe local weather prevented or interfered with station operations.
OTHER – SEE COMMENTS	See the comments for a description of the problem.

Table B-1 Values for the Observation Keyword.

B.3 Service Request Message

The Service Request (REQ) message contains thirteen (13) keywords. Figure B-3 shows the format and description of the Service Request message. Submitting requests using the REQ message is the least preferred of the three methods now available for submitting requests. The two alternative, and more preferred, methods are: the IGS Priority & Request Map Editor (IPM) online tool, which is described in Appendix I; and the Priority/Service Request Mask (PSR) file, which is described in Section B.13.

Characteristics of the ETM+ instrument are defined in the Landsat 7 Science Data Users Guide (Reference Document 6).

Each service request message describes a single interval (a set of contiguous scenes from a single WRS path) which Landsat 7 is requested to acquire and transmit to the ground station. If there is more than one interval to request, the station may stack requests in a single file by repeating the keywords from S/C ID through REQ. TYPE as many times as there are intervals to request, up to a total of 10 intervals per file. The header keywords of TYPE and DTG and the trailer keyword of TEXTEND should appear only once in the file.

```
TYPE:                        REQ
DTG:                         2000/045:12:23:30
S/C ID:                      7
START PATH:                  023
START ROW:                   010
STOP ROW:                    036
EFFECTIVE  DATE:             2000-02-01
EXPIRATION DATE:             2000-04-01
ACQ. RATE:                   0
MINIMUM GAP:                 000
MAX. SOLAR ZENITH ANGLE:
REQ. TYPE:                   GNC
TEXTEND:
```

KEYWORD	VALUE	DESCRIPTION
TYPE:	REQ	Identifies this as a Service Request message
DTG:	yyyy/ddd:hh:mm:ss where yyyy = 1997 - 2100 (year) ddd = 001 - 366 (day of year) hh = 00 - 23 (hours) mm = 00 - 59 (minutes) ss = 00 - 59 (seconds)	Identifies the date and time of creation of the message
S/C ID:	7	Landsat 7

Figure B-3 Service Request Message Format. (1 of 3)

KEYWORD	VALUE	DESCRIPTION
START PATH:	xxx = 001 - 233	The WRS path associated with the first scene being requested
START ROW:	xxx = 001 - 248	The WRS row associated with the first scene being requested
STOP ROW:	xxx = 001 - 248	The WRS row associated with the last scene being requested. Must be greater than or equal to START ROW value.
EFFECTIVE DATE:	yyyy-mm-dd where yyyy = 1997 - 2100 (year) mm = 01 - 12 (month) dd = 01 - 31 (day)	The date on which the request becomes active for scheduling.
EXPIRATION DATE:	yyyy-mm-dd (same as above)	The last date on which the request is eligible for scheduling. Acquisitions will not be scheduled after this date.
ACQ. RATE:	x where x = 0 for acquire every opportunity x = 1 for acquire once only	The rate at which acquisitions should be made. Used in conjunction with MINIMUM GAP. **RECOMMENDATION**: always set to 0
MINIMUM GAP:	xxx = 000 - 366	The minimum acceptable number of days between acquisitions. **RECOMMENDATION**: always set to 000
MAX. SOLAR ZENITH ANGLE:	xx where xx = 00 - 90 degrees xx = blank (use the default values)	Maximum acceptable solar zenith angle. If desired, this field may be left blank to trigger use of the default maximum solar zenith angle (75º in Northern Hemisphere; 85º in Southern Hemisphere). The default setting is documented in the Long-Term Acquisition Plan (Reference Document 11). **RECOMMENDATION**: always leave blank During scheduling, the request will not be scheduled if the calculated solar zenith angle on the day of acquisition exceeds the maximum angle specified in the request.

Figure B-3 Service Request Message Format. (2 of 3)

KEYWORD	VALUE	DESCRIPTION
REQ. TYPE:	xxx where xxx = 3-letter station id in Table H-1	Identifies the IGS submitting the request.
		Repeat keywords S/C ID through REQ. TYPE for each successive interval being requested, up to a total of 10 intervals.
TEXTEND:		Indicates the end of the message.

Figure B-3 Service Request Message Format. (3 of 3)

B.4 Contact Schedule Message

The Contact Schedule (SCH) message contains four (4) keywords. Figure B-4 shows the format and description of the Contact Schedule message.

If there is more than one scheduled acquisition to report, the MOC may repeat the SCHEDULED EVENT keyword for each subsequent acquisition to be reported. The TEXTEND keyword should be last keyword of the message.

If there are no scheduled acquisitions to report (i.e., acquisitions were requested but not scheduled), the file will be generated with the TYPE, DTG, and TEXTEND keywords only.

The message covers 37 hours of events; however, the last 13 hours is for information only and may change when the scheduling is performed on the next day.

Note that some of the information in the message is not needed by the ground station to perform their operations. However, the additional information may be of value in resolving operational problems.

Note: Table B-2 lays out the timing of the events within the contact and the content of the downlink data stream, using the times in the example below.

```
TYPE:               SCH
DTG:                2000/047:20:01:36
SCHEDULED EVENT:    7 2000-02-17:12:37:45 12:37:51 2000-02-17:12:39:25 12:39:26
                    XM 1
TEXTEND:
```

KEYWORD	VALUE	DESCRIPTION
TYPE:	SCH	Identifies this as a Contact Schedule message
DTG:	yyyy/ddd:hh:mm:ss where yyyy = 1997 - 2100 (year) ddd = 001 - 366 (day of year) hh = 00 - 23 (hours) mm = 00 - 59 (minutes) ss = 00 - 59 (seconds)	Identifies the date and time of creation of the message

Figure B-4 Contact Schedule Message Format. (1 of 2)

KEYWORD	VALUE	DESCRIPTION
SCHEDULED EVENT:	7 fields as defined below, separated by ASCII space	Defines the parameters of a scheduled downlink to the IGS
	7	Source of the data (Landsat 7)
	yyyy-mm-dd:hh:mm:ss where: yyyy = 1997 - 2100 (year) mm = 01 - 12 (month) dd = 01 - 31 (day) hh = 00 - 23 (hour) mm = 00 - 59 (minute) ss = 00 - 59 (second)	GMT date and time that the satellite transmitter will be turned on (AOS). The AOS is 6 seconds prior to the first requested data block. The ETM+ is on at AOS; valid PCD data and video data format are downlinked. Major frames and time code can be detected and synchronized. Actual video data may not yet be valid if this is still within the ETM+ warm-up period. (Ref. Table B-2)
	hh:mm:ss (same as above)	GMT time that the first requested data block will be received. This includes the 6-second header data available to process the first requested WRS row. (Ref. Table B-2)
	yyyy-mm-dd:hh:mm:ss (same as above)	GMT date and time that the last requested data block will be received. This includes the 18-second trailer data available to process the last requested WRS row. (Ref. Table B-2)
	hh:mm:ss (same as above)	GMT time that the satellite transmitter will be turned off (LOS). The LOS is 1 second after the last data block. The ETM+ is turned off after LOS.
	xx = XL (low freq., 8082.5 MHz) = XM (mid freq., 8212.5 MHz) = XH (high freq., 8342.5 MHz)	Carrier frequency that will be used
	x = 1, 2 or 3	Satellite antenna that will be used
TEXTEND:		Indicates the end of the message

Figure B-4 Contact Schedule Message Format. (2 of 2)

FIELD IN SCH MESSAGE	EVENT; DATA CONTENT	COMMENTS
AOS [2000-02-17:12:37:45 in the example]	Preamble ETM+ is on PCD valid Time code valid Major frame structure valid CADUs valid Scan line start valid	Station recorders can be started at this point. Currently set to 6 seconds.
FIRST DATA BLOCK [12:37:51 in the example]	Header data	Immediately precedes first requested WRS scene. Currently set to 6 seconds.
(12:37:57)	Start of requested WRS scenes	Time is not given in the SCH message.
(12:39:07)	End of requested WRS scenes Start of trailer data	Time is not given in the SCH message. Trailer data immediately follows last requested WRS scene. Currently set to 18 seconds.
LAST DATA BLOCK [2000-02-17:12:39:25 in the example]	Post-amble	Currently set to 1 second.
LOS [12:39:26 in the example]	End of X-band signal	Station recorders can be stopped at this point. ETM+ is commanded off after LOS

Table B-2 Breakdown of Event Timing During a Contact.

B.5 Station Description Message

The Station Description (DES) message contains twenty-three (23) keywords. Figure B-5 shows the format and description of the Station Description message.

A Station Description message is required for each site that will be receiving X-band data. For example, Canada must submit two Station Description messages, one for the Prince Albert site and one for the Gatineau site.

TYPE:	DES
DTG:	1999/139:17:01:00
EFFECTIVITY:	1999/139
STATION ID:	HOA
CONTACT PERSON:	Warren Serone
CONTACT TITLE:	Station Manager
MAILING ADDRESS 1:	Australian Centre for Remote Sensing
MAILING ADDRESS 2:	PO Box 1461
MAILING ADDRESS 3:	Alice Springs NT
MAILING ADDRESS 4:	Australia 0871
VOICE PHONE NO:	61 8 89523911
FAX PHONE NO:	61 8 89530557
IGS E-MAIL ADDRESS TO BE USED BY THE MOC/MMO:	acresdaf@auslig.gov.au
IGS E-MAIL ADDRESS TO BE USED BY THE DAAC:	acresdaf@auslig.gov.au
ORBITAL ELEMENTS TYPE:	NOR
ANTENNA LATITUDE:	S 42.55.32
ANTENNA LONGITUDE:	E 147 25 14
ANTENNA ALTITUDE:	150
X-BAND FREQ. HIGH:	YES
X-BAND FREQ. MID:	YES
X-BAND FREQ. LOW:	YES
NEED S-BAND BEACON:	NO
TEXTEND:	

Figure B-5 Station Description Message Format. (1 of 3)

KEYWORD	VALUE	DESCRIPTION
TYPE:	DES	Identifies this as a Station Description message
DTG:	yyyy/ddd:hh:mm:ss where yyyy = 1997 - 2100 (year) ddd = 001 - 366 (day of year) hh = 00 - 23 (hours) mm = 00 - 59 (minutes) ss = 00 - 59 (seconds)	Identifies the date and time of creation of the message
EFFECTIVITY:	yyyy/ddd (same as above)	Identifies the first date on which the following information comes into effect
STATION ID:	xxx as defined in Table H-1	Identifies the station to which the following information applies
CONTACT PERSON:	free-form text	Name of a person who can be contacted if required for operational purposes
CONTACT TITLE:	free-form text	Title of the contact person
MAILING ADDRESS 1:	free-form text	First line of the mailing address for the station
MAILING ADDRESS 2:	free-form text	Second line of the mailing address for the station
MAILING ADDRESS 3:	free-form text	Third line of the mailing address for the station
MAILING ADDRESS 4:	free-form text	Fourth line of the mailing address for the station
VOICE PHONE NO:	xxx yyy zzzzzzzz 3 fields separated by blanks, where xxx = 1-3 character country code yyy = 1-3 character city or area code zzzzzzzz = 4-8 character local number	Phone number for the contact person
FAX PHONE NO:	xxx yyy zzzzzzzz (same as above)	Facsimile phone number for the station
IGS E-MAIL ADDRESS TO BE USED BY THE MOC/MMO:	free-form text	Electronic mail address for messages from the MOC and MMO
IGS E-MAIL ADDRESS TO BE USED BY THE DAAC:	free-form text	Electronic mail address for messages from the DAAC

Figure B-5 Station Description Message Format. (2 of 3)

KEYWORD	VALUE	DESCRIPTION
ORBITAL ELEMENTS TYPE:	xxx where BME = Brouwer Mean Elements IRV = Improved Inter-Range Vectors NOR = NORAD 2-line Elements	The type of satellite orbit definition message desired by the station for use in ground antenna pointing during Landsat 7 acquisition.
ANTENNA LATITUDE:	x dd mm ss where x = N for North or S for South dd = 00 - 90 degrees mm = 00 - 59 minutes ss = 00 - 59 seconds	The latitude of the station antenna.
ANTENNA LONGITUDE:	x ddd mm ss where x = E for East or W for West ddd = 00 - 180 degrees mm = 00 - 59 minutes ss = 00 - 59 seconds	The longitude of the station antenna.
ANTENNA ALTITUDE:	xxxx (meters)	The altitude of the station antenna.
X-BAND FREQ. HIGH:	xxx where YES = station can receive High NO = station cannot receive High	Indicates whether the station can receive and process the high frequency X-band link that operates at 8342.5 MHz.
X-BAND FREQ. MID:	xxx where YES = station can receive Mid NO = station cannot receive Mid	Indicates whether the station can receive and process the mid frequency X-band link which operates at 8212.5 MHz.
X-BAND FREQ. LOW:	xxx where YES = station can receive Low NO = station cannot receive Low	Indicates whether the station can receive and process the low frequency X-band link that operates at 8082.5 MHz.
NEED S-BAND BEACON:	xxx where YES = need S-band to acquire NO = don’t need S-band	Indicates whether the station requires an S-band signal to aid in acquisition tracking of the satellite prior to X-band signal receipt
TEXTEND:		Indicates the end of the message

Figure B-5 Station Description Message Format. (3 of 3)

B.6 Receive Antenna Horizon Mask Message

The Receive Antenna Horizon Mask (MSK) message contains forty-one (41) keywords. Figure B-6 shows the format of the Receive Antenna Horizon Mask message. A Receive Antenna Horizon Mask message is required for each site that will receive X-band data. For example, Japan must submit two Receive Antenna Horizon Mask messages, one for the Hatoyama site and one for the Kumomoto site. Antenna mask data is provided in one (1) degree increments of azimuth, from 000 through 359. If a station does not provide a horizon mask, a default mask of 5 degrees minimum elevation for every degree of azimuth will be used.

```
TYPE:           MSK
DTG:            1999/331:17:00:00
STATION ID:     MPS
EFFECTIVITY:    1999/331
000-009:        04.200 04.200 04.200 04.000 02.800 02.800 04.200 04.400 03.900 04.100
010-019:        04.000 04.000 04.100 04.300 04.100 04.200 04.400 04.100 04.200 04.000
020-029:        04.000 04.000 04.000 03.900 03.800 03.700 03.800 03.900 03.700 03.400
030-039:        03.500 03.000 03.000 03.400 03.600 03.700 03.600 03.550 03.700 03.700
040-049:        03.700 03.600 03.500 03.400 03.350 03.320 03.310 03.250 03.000 02.900
050-059:        02.800 02.707 02.614 02.521 02.428 02.335 02.242 02.149 02.056 01.963
060-069:        01.870 01.777 01.684 01.591 01.498 01.405 01.312 01.219 01.126 01.033
070-079:        00.940 00.847 00.754 00.661 00.568 00.475 00.382 00.289 00.196 00.103
080-089:        00.010 –0.083 –0.176 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
090-099:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
100-109:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 02.110 –0.500
110-119:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
120-129:        –0.500 –0.500 –0.500 –0.500 –0.500 01.890 –0.500 –0.500 –0.500 –0.500
130-139:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
140-149:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 04.000 04.300 04.500
150-159:        04.580 04.500 04.300 04.000 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
160-169:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.290 –0.100 00.000 00.020 00.040
170-179:        00.060 00.065 00.070 00.070 00.070 00.070 00.070 00.070 00.070 00.080
180-189:        00.080 00.080 00.080 00.080 00.070 00.070 00.070 00.060 00.060 00.060
190-199:        00.050 00.040 00.040 00.030 00.020 00.020 00.010 00.010 00.010 00.010
200-209:        00.010 00.000 00.000 00.000 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
210-219:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
220-229:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
230-239:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
240-249:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
250-259:        –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500 –0.500
260-269:        –0.500 –0.500 –0.500 –0.446 –0.392 –0.339 –0.285 –0.232 –0.178 –0.125
270-279:        –0.071 –0.017 00.035 00.089 00.142 00.196 00.250 00.303 00.357 00.410
280-289:        00.464 00.517 00.571 00.625 00.678 00.732 00.785 00.839 00.892 00.946
290-299:        01.000 01.200 01.400 01.600 01.800 02.000 01.500 01.400 01.300 01.350
300-309:        01.200 01.200 01.600 01.600 02.930 01.600 01.600 01.600 01.600 01.600
310-319:        01.600 01.550 01.500 01.660 01.820 01.980 02.140 02.300 02.300 02.300
320-329:        02.300 02.350 02.700 03.000 03.200 02.800 02.800 02.900 03.000 03.100
330-339:        03.200 03.050 03.050 03.300 03.200 03.500 03.400 03.700 03.700 03.500
340-349:        03.500 03.400 03.300 03.700 03.800 03.700 03.800 03.200 03.200 03.300
350-359:        03.400 03.100 03.100 03.200 04.000 04.100 04.300 04.400 04.400 04.300
TEXTEND:
```

Figure B-6 Receive Antenna Horizon Mask Message Format. (1 of 3)

KEYWORD	VALUE	DESCRIPTION
TYPE:	MSK	Receive Antenna Horizon Mask message
DTG:	yyyy/ddd:hh:mm:ss where yyyy = 1997 - 2100 (year) ddd = 001 - 366 (day of year) hh = 00 - 23 (hours) mm = 00 - 59 (minutes) ss = 00 - 59 (seconds)	Identifies the date and time of creation of the message
STATION ID:	xxx as defined in Table H-1	Identifies the station to which the following information applies
EFFECTIVITY:	yyyy/ddd (same as above)	Identifies the first date on which the following information comes into effect
000-009:	10 fields, separated by ASCII space where xx.xxx = 00.000 - 90.000 degrees	Receive antenna elevation angle from the horizon, at each degree azimuth from 000 to 009
010-019:	same as for 000-009	for each degree azimuth from 010 to 019
020-029:	same as for 000-009	for each degree azimuth from 020 to 029
030-039:	same as for 000-009	for each degree azimuth from 030 to 039
040-049:	same as for 000-009	for each degree azimuth from 040 to 049
050-059:	same as for 000-009	for each degree azimuth from 050 to 059
060-069:	same as for 000-009	for each degree azimuth from 060 to 069
070-079:	same as for 000-009	for each degree azimuth from 070 to 079
080-089:	same as for 000-009	for each degree azimuth from 080 to 089
090-099:	same as for 000-009	for each degree azimuth from 090 to 099
100-109:	same as for 000-009	for each degree azimuth from 100 to 109
110-119:	same as for 000-009	for each degree azimuth from 110 to 119
120-129:	same as for 000-009	for each degree azimuth from 120 to 129
130-139:	same as for 000-009	for each degree azimuth from 130 to 139
140-149:	same as for 000-009	for each degree azimuth from 140 to 149
150-159:	same as for 000-009	for each degree azimuth from 150 to 159
160-169:	same as for 000-009	for each degree azimuth from 160 to 169
170-179:	same as for 000-009	for each degree azimuth from 170 to 179
180-189:	same as for 000-009	for each degree azimuth from 180 to 189
190-199:	same as for 000-009	for each degree azimuth from 190 to 199
200-209:	same as for 000-009	for each degree azimuth from 200 to 209
210-219:	same as for 000-009	for each degree azimuth from 210 to 219
220-229:	same as for 000-009	for each degree azimuth from 220 to 229
230-239:	same as for 000-009	for each degree azimuth from 230 to 239
240-249:	same as for 000-009	for each degree azimuth from 240 to 249
250-259:	same as for 000-009	for each degree azimuth from 250 to 259
260-269:	same as for 000-009	for each degree azimuth from 260 to 269
270-279:	same as for 000-009	for each degree azimuth from 270 to 279

Figure B-6 Receive Antenna Horizon Mask Message Format. (2 of 3)

KEYWORD	VALUE	DESCRIPTION
280-289:	same as for 000-009	for each degree azimuth from 280 to 289
290-299:	same as for 000-009	for each degree azimuth from 290 to 299
300-309:	same as for 000-009	for each degree azimuth from 300 to 309
310-319:	same as for 000-009	for each degree azimuth from 310 to 319
320-329:	same as for 000-009	for each degree azimuth from 320 to 329
330-339:	same as for 000-009	for each degree azimuth from 330 to 339
340-349:	same as for 000-009	for each degree azimuth from 340 to 349
350-359:	same as for 000-009	for each degree azimuth from 350 to 359
TEXTEND:		Indicates the end of the message.

Figure B-6 Receive Antenna Horizon Mask Message Format. (3 of 3)

B.7 Brouwer Mean Element Message

The Brouwer Mean Element (BME) message is a standard message from Goddard Space Flight Center. The introductory paragraph of the message identifies the satellite, epoch and coordinate system. The elements and inertial coordinates are then listed. There is a text trailer. Figure B-7 shows the format and description of the Brouwer Mean Element message.

Each line in the BME is ended with a carriage return followed by a line feed. Each field within a line is separated from the next field by one (1) ASCII space unless otherwise specified.

```
THE FOLLOWING ARE THE BROUWER MEAN ORBITAL ELEMENTS FOR SATELLITE
1999 20A LANDSAT 7 COMPUTED AND ISSUED BY THE GODDARD
SPACE FLIGHT CENTER.  EPOCH 2000 Y 2 M 17 D 12 H 0 M 0.000 S UT.
THE FOLLOWING ARE THE GEOCENTRIC TRUE OF DATE ELEMENTS


        SEMI-MAJOR AXIS              7077.6922  KILOMETERS
        ECCENTRICITY                0.00003059
        INCLINATION                    98.2030  DEGREES
        MEAN ANOMALY                  266.9095  DEGREES
        ARG. OF PERIFOCUS              65.9851  DEGREES
          MOTION         MINUS          3.1088  DEG. PER DAY
        R.A. OF ASCEND. NODE          118.0356  DEGREES
          MOTION        PLUS            0.9877  DEG. PER DAY
        ANOMALISTIC PERIOD            98.76370  MINUTES
        PERIOD DOT       PLUS           0.0000  MIN. PER DAY
        HT. OF PERIFOCUS               699.339  KILOMETERS
        HT. OF APOFOCUS                699.772  KILOMETERS
        VEL. AT PERIFOCUS               27017.  KM. PER HR.
        VEL. AT APOFOCUS                27015.  KM. PER HR.
        GEOC. LAT. OF PERIFOCUS         64.701  DEGREES
        PLUS


        INERTIAL COORDINATES REFERENCE TRUE OF DATE

        X                           -3370.3596  KILOMETERS
        Y                            5344.3293  KILOMETERS
        Z                           -3209.1582  KILOMETERS
        X DOT                       -0.7709179  KM. PER SEC.
        Y DOT                        3.4709980  KM. PER SEC.
        Z DOT                        6.6012626  KM. PER SEC.
** THE END NO MORE INPUT****
```

Figure B-7 Brouwer Mean Element Message Format. (1 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
1	65	"THE FOLLOWING ARE THE BROUWER MEAN ORBITAL ELEMENTS FOR SATELLITE"	Text field - identifies the type of message
2		4 fields as defined below, separated by an ASCII space	
	4	yyyy = 1999	Year of satellite launch
	3	20A	Launch identification
	9	LANDSAT 7	Satellite name
	34	"COMPUTED AND ISSUED BY THE GODDARD"	Text field
3		13 fields as defined below, separated by an ASCII space	
	27	"SPACE FLIGHT CENTER. EPOCH"	Text field
	4	yyyy = 1997 - 2100	Year of epoch
	1	"Y"	Indicates preceding field is year
	2	mm = 01 - 12	Month of epoch
	1	"M"	Indicates preceding field is month
	2	dd = 01 - 31	Day of epoch
	1	"D"	Indicates preceding field is day
	2	hh = 00 - 23	Hour of epoch
	1	"H"	Indicates preceding field is hours
	2	nn = 00 - 59	Minutes of epoch
	1	"M"	Indicates preceding field is minutes
	6	ss.sss = 00.000 - 59.999	Seconds of epoch, specified to the millisecond
	5	"S UT."	Indicates preceding field is seconds and epoch is specified in Universal Time.
4	54	"THE FOLLOWING ARE THE GEOCENTRIC TRUE OF DATE ELEMENTS"	Text field - identifies coordinate system of elements
5	0	blank line	
6	0	blank line	
7		3 fields as defined below, the first preceded by 9 ASCII spaces	Semi-major axis in kilometers
	15	"SEMI-MAJOR AXIS" followed by 14 ASCII spaces instead of 1	Element name
	10	xxxxx.xxxx	Value
	10	"KILOMETERS"	Unit

Figure B-7 Brouwer Mean Element Message Format. (2 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
8		2 fields as defined below, the first preceded by 9 ASCII spaces	Eccentricity
	12	"ECCENTRICITY" followed by 14 ASCII spaces instead of 1	Element name
	10	x.xxxxxxxx	Value
9		3 fields as defined below, the first preceded by 9 ASCII spaces	Inclination
	11	"INCLINATION" followed by 21 ASCII spaces instead of 1	Element name
	7	xx.xxxx	Value
	7	"DEGREES"	Unit
10		3 fields as defined below, the first preceded by 9 ASCII spaces	Mean Anomaly
	12	"MEAN ANOMALY" followed by 19 ASCII spaces instead of 1	Element name
	8	xxx.xxxx	Value
	7	"DEGREES"	Unit
11		3 fields as defined below, the first preceded by 9 ASCII spaces	Argument of perifocus
	17	"ARG. OF PERIFOCUS" followed by 14 ASCII spaces instead of 1	Element name
	8	xxx.xxxx	Value
	7	"DEGREES"	Unit
12		4 fields as defined below, the first preceded by 14 ASCII spaces	First derivative of argument of perifocus
	6	"MOTION" followed by 8 ASCII spaces instead of 1	Element name
	5	" PLUS" or "MINUS", followed by 9 ASCII spaces instead of 1	Sign
	6	x.xxxx	Value
	12	"DEG. PER DAY"	Unit
13		3 fields as defined below, the first preceded by 9 ASCII spaces	Right ascension of ascending node
	20	"R.A. OF ASCEND. NODE" followed by 11 ASCII spaces instead of 1	Element name
	8	xxx.xxxx	Value
	7	"DEGREES"	Unit

Figure B-7 Brouwer Mean Element Message Format. (3 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
14		4 fields as defined below, the first preceded by 14 ASCII spaces	First derivative of right ascension of ascending node
	6	"MOTION" followed by 8 ASCII spaces instead of 1	Element name
	5	" PLUS" or "MINUS", followed by 9 ASCII spaces instead of 1	Sign
	6	x.xxxx	Value
	12	"DEG. PER DAY"	Unit
15		3 fields as defined below, the first preceded by 9 ASCII spaces	Anomalistic period
	18	"ANOMALISTIC PERIOD" followed by 11 ASCII spaces instead of 1	Element name
	10	xxxx.xxxxx	Value
	7	"MINUTES"	Unit
16		4 fields as defined below, the first preceded by 9 ASCII spaces	Period dot
	10	"PERIOD DOT" followed by 9 ASCII spaces instead of 1	Element name
	5	" PLUS" or "MINUS", followed by 9 ASCII spaces instead of 1	Sign
	6	x.xxxx	Value
	12	"MIN. PER DAY"	Unit
17		3 fields as defined below, the first preceded by 9 ASCII spaces	Height of perifocus
	16	"HT. OF PERIFOCUS" followed by 14 ASCII spaces instead of 1	Element name
	9	xxxxx.xxx	Value
	10	"KILOMETERS"	Unit
18		3 fields as defined below, the first preceded by 9 ASCII spaces	Height of apofocus
	15	"HT. OF APOFOCUS" followed by 15 ASCII spaces instead of 1	Element name
	9	xxxxx.xxx	Value
	10	"KILOMETERS"	Unit
19		3 fields as defined below, the first preceded by 9 ASCII spaces	Velocity at perifocus
	17	"VEL. AT PERIFOCUS" followed by 16 ASCII spaces instead of 1	Element name
	6	xxxxx.	Value
	11	"KM. PER HR."	Unit

Figure B-7 Brouwer Mean Element Message Format. (4 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
20		3 fields as defined below, the first preceded by 9 ASCII spaces	Velocity at apofocus
	16	"VEL. AT APOFOCUS" followed by 17 ASCII spaces instead of 1	Element name
	6	xxxxx.	Value
	11	"KM. PER HR."	Unit
21		4 fields as defined below, the first preceded by 9 ASCII spaces	Geocentric latitude of perifocus
	23	"GEOC. LAT. OF PERIFOCUS"	Element name
	5	" PLUS" or "MINUS" followed by 6 ASCII spaces instead of 1	Sign
	6	xx.xxx	Value
	7	"DEGREES"	Unit
22	0	blank line	
23	0	blank line	
24	43	"INERTIAL COORDINATES REFERENCE TRUE OF DATE" preceded by 9 ASCII spaces	Header line
25	0	blank line	
26		3 fields as defined below, the first preceded by 9 ASCII spaces	X component of position vector
	1	"X" followed by 27 ASCII spaces instead of 1	Element name
	11	sxxxxx.xxxx where s = blank for positive sign or "-" for negative sign	Value
	10	"KILOMETERS"	Unit
27		3 fields as defined below, the first preceded by 9 ASCII spaces	Y component of position vector
	1	"Y" followed by 27 ASCII spaces instead of 1	Element name
	11	sxxxxx.xxxx where s = blank for positive sign or "-" for negative sign	Value
	10	"KILOMETERS"	Unit

Figure B-7 Brouwer Mean Element Message Format. (5 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
28		3 fields as defined below, the first preceded by 9 ASCII spaces	Z component of position vector
	1	"Z" followed by 27 ASCII spaces instead of 1	Element name
	11	sxxxxx.xxxx where s = blank for positive sign or "-" for negative sign	Value
	10	"KILOMETERS"	Unit
29		3 fields as defined below, the first preceded by 9 ASCII spaces	X component of velocity vector
	5	"X DOT" followed by 24 ASCII spaces instead of 1	Element name
	10	sx.xxxxxxx where s = blank for positive sign or "-" for negative sign	Value
	12	"KM. PER SEC."	Unit
30		3 fields as defined below, the first preceded by 9 ASCII spaces	Y component of velocity vector
	5	"Y DOT" followed by 24 ASCII spaces instead of 1	Element name
	10	sx.xxxxxxx where s = blank for positive sign or "-" for negative sign	Value
	12	"KM. PER SEC."	Unit
31		3 fields as defined below, the first preceded by 9 ASCII spaces	Z component of velocity vector
	5	"Z DOT" followed by 24 ASCII spaces instead of 1	Element name
	10	sx.xxxxxxx where s = blank for positive sign or "-" for negative sign	Value
	12	"KM. PER SEC."	Unit
32	28	"** THE END NO MORE INPUT****"	Indicates the end of the message

Figure B-7 Brouwer Mean Element Message Format. (6 of 6)

B.8 Improved Inter-Range Vector Message

The Improved Inter-Range Vector (IRV) message is a standard message from Goddard Space Flight Center (GSFC). The message contains six (6) lines. Figure B-8 shows the format and description of the Improved Inter-Range Vector message.

Each of the six lines in the message is terminated by two (2) carriage returns followed by two (2) line feeds. There are no spaces between fields on a line.

If there are multiple vectors being sent in the same message, the following will be repeated for each subsequent vector:

- the last three fields of line 1 (starting with "GIIRV")
- lines 2 through 6 in their entirety

```
030074200010GIIRV MANY
1111736801000047000000000040
 000005194645-000003407788 000003393221095
-000003893639 000000553527 000006494654107
00020410015210200 0000000018
ITERM GAQD
```

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
1		7 fields as defined below	
	2	03	Message Type (Operations Data Message)
	7	uuuuuuu = 0000100 - 9999900 (updated in increments of 100)	Message ID
	1	0	Message source (Flight Dynamics Facility)
	2	10	Message class (nominal)
	5	"GIIRV"	Message start
	1	ASCII space	Originator of message (GSFC)
	4	"MANY"	Routing indicator (multiple destinations)

Figure B-8 Improved Inter-Range Vector Message Format. (1 of 4)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
2		10 fields as defined below	
	1	1	Vector type (free flight, routine on-orbit)
	1	1	Data source (nominal/planning)
	1	1	Transfer type (Interrange)
	1	1	Coordinate system (Geocentric true-of-date rotation)
	4	7368	Support Identification Code
	2	01	Vehicle Identification Code
	3	nnn = 000 - 999	Sequence number incremented for each vector in a set of vector data
	3	ddd = 001 - 366	Day of year
	9	hhmmsssss where hh = 00 - 23 (hours) mm = 00 - 59 (minutes) sssss = 00000 - 59999 (milliseconds - implied decimal is three places from the right)	Vector epoch in UTC
	3	ccc	Checksum for line 2; calculated by summing the decimal equivalent of the preceding characters in the line, counting spaces as 0 and negative signs as 1
3		4 fields as defined below	
	13	sxxxxxxxxxxxx where s = "-" for negative sign or ASCII space for positive sign	X component of the position vector in meters
	13	syyyyyyyyyyyy where s = "-" for negative sign or ASCII space for positive sign	Y component of the position vector in meters
	13	szzzzzzzzzzzz where s = "-" for negative sign or ASCII space for positive sign	Z component of the position vector in meters
	3	ccc	Checksum for line 3

Figure B-8 Improved Inter-Range Vector Message Format. (2 of 4)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
4		4 fields as defined below	
	13	sxxxxxxxxxxxx where s = "-" for negative sign or ASCII space for positive sign	X component of the velocity vector in meters per second, with a resolution to the nearest millimeter per second; assumed decimal point is three places from the right.
	13	syyyyyyyyyyyy where s = "-" for negative sign or ASCII space for positive sign	Y component of the velocity vector in meters per second, with a resolution to the nearest millimeter per second; assumed decimal point is three places from the right.
	13	szzzzzzzzzzzz where s = "-" for negative sign or ASCII space for positive sign	Z component of the velocity vector in meters per second, with a resolution to the nearest millimeter per second; assumed decimal point is three places from the right.
	3	ccc	Checksum for line 4
5		5 fields as defined below	
	8	mmmmmmmm Must contain all zeros if not used	Mass of the satellite in kilograms with a resolution to the nearest tenth of a kilogram; assumed decimal point is one place from the right.
	5	aaaaa Must contain all zeros if not used	Average satellite cross-sectional area in square meters with a resolution to the nearest hundredth of a square meter; assumed decimal point is two places from the right.
	4	kkkk Must contain all zeros if not used	Dimensionless drag coefficient; assumed decimal point is two places from the right.
	8	srrrrrrr where s = "-" for negative sign or ASCII space for positive sign Must contain all zeros if not used	Dimensionless solar reflectivity coefficient; assumed decimal point is six places from the right.
	3	ccc	Checksum for line 5

Figure B-8 Improved Inter-Range Vector Message Format. (3 of 4)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
6		3 fields as defined below	
	5	"ITERM"	Indicates end of message
	1	ASCII blank	
	4	"GAQD"	Originator routing
7	10	"GIIRV MANY"	Identifies message start, originator and routing indicator for second vector set
8-12		same as lines 2-6 for second vector set	Second vector set
		repeat lines 7-12 for each subsequent vector set	Additional vector sets

Figure B-8 Improved Inter-Range Vector Message Format. (4 of 4)

B.9 NORAD Two Line Element Message

The NORAD Two Line Element (NOR) message is generated by the MOC orbit determination system on a daily basis.

The message contains two (2) lines. Figure B-9 shows the format and description of the NORAD Two Line Element message. There is an ASCII space between each field on each line. The first line is terminated with a carriage return and a line feed.

```
1 25682U 99020A   00047.20048522  .00001359  00000-0  31145-3 0  2175
2 25682  98.2001 116.7565 0001093  89.5653 270.5671 14.57123914 44648
```

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
1		9 fields as described below	
	1	1	Line number
	6	sssssU where sssss = 25682	Satellite number and classification (Unclassified)
	8	99lllvvv where lll = 020 (launch number of year) vvv = A followed by 2 ASCII spaces (vehicle identifier)	International designator for Landsat 7
	14	yyddd.dddddddd where yy = 00 - 99 (last two digits of year) ddd.dddddddd = 000.00000000 - 365.99999999 (day and fraction of day)	Epoch year and day
	10	s.mmmmmmmm where s = blank for positive value or s = "-" for negative value	First time derivative of Mean Motion, in revolutions per day^2
	8	smmmmm-m where s = blank for positive value or s = "-" for negative value	Second time derivative of Mean Motion, in revolutions per day^3 Decimal point is assumed. Field is usually zero-filled.
	8	sddddd-d where s = blank for positive value or s = "-" for negative value	BSTAR drag term if GP4 general perturbations theory was used; otherwise, is radiation pressure coefficient Decimal point is assumed.

Figure B-9 NORAD Two Line Element Message Format. (1 of 2)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
	1	0	Ephemeris type (mean inertial)
	5	nnnnc where nnnn = 0000 - 9999 (element number) c = 0 - 9 (line checksum, modulo 10)	Element number and line checksum
2		8 fields as described below	
	1	2	Line number
	5	sssss = 25682 (satellite number)	Satellite number
	8	iii.iiii = 098.0000 - 098.5000 (degrees)	Inclination
	8	rrr.rrrr = 000.0000 - 360.0000 (degrees)	Right ascension of ascending node
	7	eeeeeee	Eccentricity; decimal point is assumed at beginning of the field
	8	ppp.pppp = 075.0000 - 100.0000 (degrees)	Argument of perigee
	8	aaa.aaaa = 000.0000 - 360.0000 (degrees)	Mean anomaly
	17	rr.rrrrrrrreeeeec where rr.rrrrrrrr = 00.00000000 - 99.99999999 (mean motion in revolutions per day) eeeee = 00000 - 99999 (revolution number at epoch) c = 0 - 9 (line checksum, modulo 10)	Mean motion, epoch revolution and line checksum

Figure B-9 NORAD Two Line Element Message Format. (2 of 2)

B.10 Definitive Ephemeris Product

The Definitive Ephemeris Product being distributed by the MOC is generated daily after completion of the orbit determination processing. The message is placed on the MOC server. The same message is sent to all IGS stations.

The message contains three (3) header lines followed by up to 3660 lines of definitive ephemeris points. The nominal daily file has an end time of 1300Z on the day of creation, and a start time 61 hours earlier than that, 0000Z two days earlier. For example, the file generated on day 38 covers from day 36/0000Z through 38/1300Z. Figure B-10 shows the format and description of the Definitive Ephemeris Product file. Each line is terminated with a carriage return and a line feed.

```
"Start","Stop"
036/2000 00:00:00.000,038/2000 13:00:00.000
"Time (UTCJ4)","x (km)","y (km)","z (km)","vx (km/sec)","vy (km/sec)","vz (km/sec)"
036/2000 00:00:00.000,-2108.279002,5149.572331,-4390.199567,-0.467925,4.738106,5.788307
036/2000 00:01:00.000,-2132.093364,5423.305712,-4034.277380,-0.325609,4.383250,6.071797
036/2000 00:02:00.000,-2147.324524,5675.205786,-3662.071480,-0.181914,4.010571,6.330911
•••
038/2000 12:57:00.000,-2249.457263,4548.084772,-4949.066085,-0.933539,5.256285,5.258853
038/2000 12:58:00.000,-2300.909128,4854.105524,-4623.769404,-0.780936,4.940961,5.580751
038/2000 12:59:00.000,-2343.105264,5140.599261,-4279.823121,-0.625117,4.605600,5.880294
038/2000 13:00:00.000,-2375.871350,5406.403302,-3918.605942,-0.466706,4.251532,6.156250
```

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
1	14	“Start”,“Stop”	Label for timespan of product
2		4 fields as described below	
	9	ddd/yyyyb where ddd = 001 - 366 (3-digit day of year) “/” = separator yyyy = 1999 - 2100 (4-digit year) b = blank	Day and year of first ephemeris point in the product
	13	hh:mm:ss.sss where hh = 00 - 23 (hour) “:” = separator mm = 00 – 59 (minutes) “:” = separator ss.sss = 00.000 – 59.999 (seconds and thousandths of seconds) “,” = separator	Time of the first ephemeris point in the product

Figure B-10 Definitive Ephemeris Product. (1 of 3)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
	9	ddd/yyyyb where ddd = 001 - 366 (3-digit day of year) "/" = separator yyyy = 1999 - 2100 (4-digit year) b = blank	Day and year of last ephemeris point in the product
	12	hh:mm:ss.sss where hh = 00 - 23 (hour) ":" = separator mm = 00 – 59 (minutes) ":" = separator ss.sss = 00.000 – 59.999 (seconds and thousandths of seconds)	Time of the last ephemeris point in the product
3		7 fields, as described below	
	15	"Time (UTCJ4)",	Label for timetag associated with this point
	9	"x (km)",	Label for X-axis position
	9	"x (km)",	Label for Y-axis position
	9	"x (km)",	Label for Z-axis position
	14	"vx (km/sec)",	Label for X-axis velocity
	14	"vx (km/sec)",	Label for Y-axis velocity
	13	"vx (km/sec)"	Label for Z-axis velocity
4-3660		8 fields, as described below	
	9	ddd/yyyyb where ddd = 001 - 366 (3-digit day of year) "/" = separator yyyy = 1999 - 2100 (4-digit year) b = blank	Day and year of this ephemeris point
	13	hh:mm:ss.sss, where hh = 00 - 23 (hour) ":" = separator mm = 00 – 59 (minutes) ":" = separator ss.sss = 00.000 – 59.999 (seconds and thousandths of seconds) "," = separator	Time of the this ephemeris point

Figure B-10 Definitive Ephemeris Product. (2 of 3)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
	13	sNn.nnnnnn, where s = “-“ for negative value, is omitted for positive value N= 0 – 9 (could be from 0-3 digits long) n.nnnnnn = 0.000000 – 9.999999 “,” = separator	X-axis position of this ephemeris point – J2000 ECI Will be zero-filled for the 5 minutes following the time of an orbit maneuver.
	13	sNn.nnnnnn, where s = “-“ for negative value, is omitted for positive value N= 0 – 9 (could be from 0-3 digits long) n.nnnnnn = 0.000000 – 9.999999 “,” = separator	Y-axis position of this ephemeris point– J2000 ECI Will be zero-filled for the 5 minutes following the time of an orbit maneuver.
	13	sNn.nnnnnn, where s = “-“ for negative value, is omitted for positive value N= 0 – 9 (could be from 0-3 digits long) n.nnnnnn = 0.000000 – 9.999999 “,” = separator	Z-axis position of this ephemeris point– J2000 ECI Will be zero-filled for the 5 minutes following the time of an orbit maneuver.
	10	sn.nnnnnn, where s = “-“ for negative value, is omitted for positive value n.nnnnnn = 0.000000 – 9.999999 “,” = separator	X-axis velocity of this ephemeris point– J2000 ECI Will be zero-filled for the 5 minutes following the time of an orbit maneuver.
	10	sn.nnnnnn, where s = “-“ for negative value, is omitted for positive value n.nnnnnn = 0.000000 – 9.999999 “,” = separator	Y-axis velocity of this ephemeris point– J2000 ECI Will be zero-filled for the 5 minutes following the time of an orbit maneuver.
	9	sn.nnnnnn, where s = “-“ for negative value, is omitted for positive value n.nnnnnn = 0.000000 – 9.999999 “,” = separator	Z-axis velocity of this ephemeris point– J2000 ECI Will be zero-filled for the 5 minutes following the time of an orbit maneuver.

Figure B-10 Definitive Ephemeris Product. (3 of 3)

B.11 Acquired Scenes Report

The Acquired Scenes report is generated after every scheduling run that includes the successful scheduling of IGS requests. A report is generated for each station. In each report, the scenes that were successfully scheduled are described in terms of time, orbit number, downlink frequency, gain settings, sun angle, predicted cloud cover. The report is placed in each station's directory on the MOC server, at the same time as the Contact Schedule messages.

For each path/row scheduled, there is one line in the report. There is a line for the partial scenes that were scheduled as header or trailer data. There are also entries for each occurrence of PN data (pseudo-random noise data used as filler) scheduled during the station contact period. The file nominally covers 37 hours of scheduled scenes to be acquired by the station. Figure B-11 shows the detailed format of the report.

```
Trace enabled 2000:045:19:52:14 User: OPS$LONIGRO
---------------------------------------------------------------------------------------------
---               W I D E B A N D   D O W N L I N K   R E P O R T
---                      Report Date     : 2000:045:19:52:14
---                      Report Period   : 2000:045:20:29:44
---                                 to   : 2000:047:12:29:44
---------------------------------------------------------------------------------------------

     _______Source                                                               ACCA_____________
    /   ____Station              _Duration  __Frequency                          Predicted CC__   \
   /   /  __Subinterval Type    /          / _Antenna   _Request Type            Sun Angle_    \   \
  /   /  /                     / Downlink / /          /                  Acq.             \    \   \
 /   /  /   Downlink Time     /  Orbit   / /  WRS     /  Acquisition Time Orbit  Gains      \    \   \
-- --- -- ----------------- ---- ------ - - ------- --- ----------------- ------ --------- ----- --- ---
RT COA EH 2000:046:13:12:26   12 004455 M 1
RT COA FL 2000:046:13:12:38   23 004455 M 1 222/069 GAR 2000:046:13:12:38 004455 HHHLHLHHL  56.7  67 ...
RT COA FL 2000:046:13:13:01   24 004455 M 1 222/070 GAR 2000:046:13:13:01 004455 HHHLHLHHL  56.5  45 ...
RT COA FL 2000:046:13:13:25   24 004455 M 1 222/071 ... 2000:046:13:13:25 004455 HHHLHLHHL  56.3 ... ...
RT COA FL 2000:046:13:13:49   24 004455 M 1 222/072 GAR 2000:046:13:13:49 004455 HHHLHLHHL  56.0  23 ...
RT COA FL 2000:046:13:14:13   24 004455 M 1 222/073 GAR 2000:046:13:14:13 004455 HHHLHLHHL  55.7  53 ...
RT COA FL 2000:046:13:14:37   24 004455 M 1 222/074 GAR 2000:046:13:14:37 004455 HHHLHLHHL  55.4  30 ...
RT COA FL 2000:046:13:15:01   24 004455 M 1 222/075 GAR 2000:046:13:15:01 004455 HHHLHLHHL  55.0  20 ...
RT COA FL 2000:046:13:15:25   24 004455 M 1 222/076 GAR 2000:046:13:15:25 004455 HHHLHLHHL  54.5  45 ...
RT COA FL 2000:046:13:15:49   24 004455 M 1 222/077 IGS 2000:046:13:15:49 004455 HHHLHLHHL  54.0  75 ...
RT COA FL 2000:046:13:16:13   24 004455 M 1 222/078 IGS 2000:046:13:16:13 004455 HHHLHLHHL  53.4  99 ...
RT COA FL 2000:046:13:16:37   24 004455 M 1 222/079 IGS 2000:046:13:16:37 004455 HHHLHLHHL  52.8  94 ...
RT COA FL 2000:046:13:17:01   24 004455 M 1 222/080 IGS 2000:046:13:17:01 004455 HHHLHLHHL  52.2  99 ...
RT COA FL 2000:046:13:17:25   24 004455 M 1 222/081 IGS 2000:046:13:17:25 004455 HHHLHLHHL  51.5  67 ...
RT COA FL 2000:046:13:17:49   24 004455 M 1 222/082 IGS 2000:046:13:17:49 004455 HHHLHLHHL  50.8  63 ...
RT COA FL 2000:046:13:18:13   24 004455 M 1 222/083 IGS 2000:046:13:18:13 004455 HHHLHLHHL  50.1  96 ...
RT COA FL 2000:046:13:18:37   24 004455 M 1 222/084 IGS 2000:046:13:18:37 004455 HHHLHLHHL  49.3  85 ...
RT COA FL 2000:046:13:19:01   24 004455 M 1 222/085 IGS 2000:046:13:19:01 004455 HHHHHLHHL  48.5 ... ...
RT COA ET 2000:046:13:19:25   18 004455 M 1
PN COA PN 2000:046:13:19:43  191 004455 M 1
RT COA EH 2000:046:13:22:54    6 004455 M 1
RT COA FL 2000:046:13:23:00   24 004455 M 1 222/095 IGS 2000:046:13:23:00 004455 HHHHHLHHL  39.2  81 ...
RT COA FL 2000:046:13:23:24   24 004455 M 1 222/096 IGS 2000:046:13:23:24 004455 HHHHHLHHL  38.1  76 ...
RT COA FL 2000:046:13:23:48   24 004455 M 1 222/097 IGS 2000:046:13:23:48 004455 HHHHHLHHL  37.1  87 ...
RT COA ET 2000:046:13:24:12   19 004455 M 1
RT COA EH 2000:046:14:50:31   12 004456 M 1
RT COA FL 2000:046:14:50:43   24 004456 M 1 005/067 GAR 2000:046:14:50:43 004456 HHHLHLHHL  56.8  74 ...
RT COA FL 2000:046:14:51:07   24 004456 M 1 005/068 GAR 2000:046:14:51:07 004456 HHHLHLHHL  56.7  74 ...
RT COA FL 2000:046:14:51:31   23 004456 M 1 005/069 GAR 2000:046:14:51:31 004456 HHHLHLHHL  56.7  86 ...
RT COA FL 2000:046:14:51:54   24 004456 M 1 005/070 GAR 2000:046:14:51:54 004456 HHHLHLHHL  56.5  95 ...
RT COA FL 2000:046:14:52:18   24 004456 M 1 005/071 GAR 2000:046:14:52:18 004456 HHHLHLHHL  56.3  40 ...
RT COA ET 2000:046:14:52:42   19 004456 M 1
```

Figure B-11 Acquired Scenes Report Format. (1 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
1	Variable	Variable	Information related to report generation; should be ignored
2	93	All hyphens	Separator
3	65	“WbIbDbEbBbAbNbDbbbDbObWbNbLbI bNbKbbbRbEbPbObRbT” where b = blank; this field is preceded by 3 hyphens and 15 blank spaces	MOC title for this report
4	60	“Report Date”bbbbb:byyyy:ddd:hh:mm:ss where “Report Date” = constant bbbbb = 5 blanks “:” = separator b = blank yyyy = 1999 – 2100 (4-digit year) “:” = separator ddd = 001 – 366 (3-digit day of year) “:” = separator hh = 00 – 23 (hours) “:” = separator mm = 00 – 59 (minutes) “:” = separator ss = 00 – 59 (seconds); this field is preceded by 3 hyphens and 22 blank spaces	Date and time report was generated
5	60	“Report Period”bbb:byyyy:ddd:hh:mm:ss where “Report Period” = constant bbb = 3 blanks “:” = separator b = blank yyyy = 1999 – 2100 (4-digit year) “:” = separator ddd = 001 – 366 (3-digit day of year) “:” = separator hh == 00 – 23 (hours) “:” = separator mm = 00 – 59 (minutes) “:” = separator ss = 00 – 59 (seconds); this field is preceded by 3 hyphens and 22 blank spaces	Start time of period covered by this report

Figure B-11 Acquired Scenes Report Format. (2 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
6	60	“to”bbb:byyy:ddd:hh:mm:ss where “to” = constant bbb = 3 blanks “:” = separator b = blank yyyy = 1999 – 2100 (4-digit year) “:” = separator ddd = 001 – 366 (3-digit day of year) “:” = separator hh == 00 – 23 (hours) “:” = separator mm = 00 – 59 (minutes) “:” = separator ss = 00 – 59 (seconds); this field is preceded by 3 hyphens and 33 blank spaces	End time of period covered by this report
7	93	All hyphens	Separator
8-14			Column headings for remainder of report
15+ (variable)		16 fields, as described below; each field, except the last one, is followed by a blank space	Information for each scene scheduled for acquisition
	2	“RT”	Indicates that source of data is a realtime downlink
	3	xxx where xxx = 3-letter station id as found in Table H-1 of this ICD	Identifies the station for which this report has been generated and to which the data will be downlinked
	2	xx where xx = “EH” for a partial scene which is the interval header “ET” for a partial scene which is the interval trailer “FL” for full scene “PN” for non-scene data (PN fill data)	Identifies the type of data being downlinked

Figure B-11 Acquired Scenes Report Format. (3 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
	17	yyyy:ddd:hh:mm:ss where yyyy = 1999 – 2100 (4-digit year) ":" = separator ddd = 001 – 366 (3-digit day of year) ":" = separator hh == 00 – 23 (hours) ":" = separator mm = 00 – 59 (minutes) ":" = separator ss = 00 – 59 (seconds)	Time at which this data is going to be downlinked to the station
	4	ssss where sss = 1 – 9999 Leading blank spaces are always used to fill out the four-byte field	Duration of the data in seconds; actual data time is truncated to whole seconds, so a full scene may be reported as 23 or as 24 seconds in length Header data at the beginning of a station contact will be 12 seconds in length, including the 6 seconds between AOS and data start, and the 6 seconds of header data itself. Trailer data at the end of a station contact will be 19 seconds in length, including 18 seconds of trailer data itself and 1 second between data stop and LOS
	6	oooooo Where oooooo = 000000 – 999999 Leading zeroes are always given.	Orbit number on which the downlink will occur. Where a scene spans the orbit boundary, the orbit number at the start of the scene is the number given.
	1	x where x = "L" for low frequency "M" for medium frequency "H" for high frequency	Frequency at which the data will be downlinked to the station. Will usually be the same for each station.

Figure B-11 Acquired Scenes Report Format. (4 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
	1	n where n = “1” for antenna 1 “2” for antenna 2 “3” for antenna 3	Number of the GXA antenna used to downlink the data to the station
	7	ppp/rrr Where ppp = 001 – 233 (WRS path) “/” = separator rrr = 001 – 248 (WRS row) Leading zeroes are always given.	WRS path/row for the data being downlinked This field is not present for header (EH), trailer (ET), or filler data (PN).
	3	xxx Where xxx = “GAR” if requested by both U.S. and the IGS “IGS” if requested only by IGS “…” if not requested but is being downlinked as a flywheel scene	Type of request that caused this scene to be scheduled and downlinked This field is not present for header (EH), trailer (ET), or filler data (PN).
	17	yyyy:ddd:hh:mm:ss where yyyy = 1999 – 2100 (4-digit year) “:” = separator ddd = 001 – 366 (3-digit day of year) “:” = separator hh == 00 – 23 (hours) “:” = separator mm = 00 – 59 (minutes) “:” = separator ss = 00 – 59 (seconds)	Time at which this data is going to be acquired by the station. This is the same time as the field “downlink time” for IGS scenes, since they are always realtime downlinks. This field is not present for header (EH), trailer (ET), or filler data (PN).

Figure B-11 Acquired Scenes Report Format. (5 of 6)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
	6	oooooo Where oooooo = 000000 – 999999 Leading zeroes are always given.	Orbit number on which the data was acquired. Will always be the same as the downlink orbit.
	9	abcdefghi where a = gain setting for band 1 b = gain setting for band 2 c = gain setting for band 3 d = gain setting for band 4 e = gain setting for band 5 f = gain setting for band 6 format 1 g = gain setting for band 6 format 2 h = gain setting for band 7 i = gain setting for band 8 The value assigned to each position is either "H" for high gain or "L" for low gain.	The gain setting during the acquisition of this data. This field is not present for header (EH), trailer (ET), or filler data (PN).
	5	snn.n where s = "-" if night scene or blank if day scene nn.n = solar zenith angle at center of the acquired scene Leading blanks are always given.	Solar zenith angle at center of the acquired scene. This field is not present for header (EH), trailer (ET), or filler data (PN).
	3	Ccc Where ccc = 0 – 100 (if available) "…" (if not available) Leading blanks are always given.	Predicted cloud cover at the acquired scene, if available. This field is not present for header (EH), trailer (ET), or filler data (PN).
	3	"…"	ACCA score calculated for this scene. Is not available for IGS scenes so is filled with periods. This field is not present for header (EH), trailer (ET), or filler data (PN).

Figure B-11 Acquired Scenes Report Format. (6 of 6)

B.12 Priority Mask Message

The Priority Mask message is used by the IGS to assign a priority of high, medium, or low to each of the scenes of interest within its acquisition circle. The message is a flat file representation of the path/row grid for the station acquisition circle. The message is generated at station start-up, placed on the MOC server via ftp, and is updated thereafter as required. Reasons for update may include changes in customer interest within the acquisition circle or addition/deletion of scenes from the circle. There are now two alternative ways to submit priority masks: the IGS Priority & Request Map Editor (IPM) online tool, which is described in Appendix I; and the Priority/Service Request Mask (PSR) file, which is described in Section B.13. Use of these two alternative methods is preferred over use of the PRI message described in this Section. It is hoped that this PRI message will eventually be phased out.

The Priority Mask message specifies the cycles over which the mask is to be used. There may be as many 23 masks (one per 16-day cycle in a year) or one mask (applicable for the entire year). Masks are reapplied year after year unless updated. Each station must have a mask, so International Cooperators responsible for more than one station must submit separate masks for each station. Figure B-12 shows the format of the Priority Mask message.

```
Station MPS
Effective Cycle 1
Expiration Cycle 23
Start Path 219
Start Row 25
 , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , ,
 , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , ,
 , , , , , , , , , , , , , , , , , ,X,X, , , , , , , , , , , ,
 , , , , , , , , , , , , , ,X,X,X,X,X,X,X,X, , , , , , , , , ,
 , , , , , , , , , , , , , ,X,X,X,X,X,X,X,X,X, , , , , , , , ,
 , , , , , , , , , , , , , ,X,X,X,X,X,X,X,X,X, , , , , , , , ,
2,2,2,2, , , , , , , , , , ,X,X,X,X,X,X,X,X,X, , , , , , , , ,
2,2,2,2,2,2, , , , , , , , ,X,X,X,X,X,X,X,X,X,X,X, , , , , , , ,
 , ,2,2,2,2, , , , , , , , ,P,X,X,X,X,X,X,X,X,X,X,X,X,X,X, , , ,
 , , , ,2,2, , , , , , , , ,P,P,X,3,3,X,X,X,X,X,X,X,X,X,X,X, , ,
 , , , , , , , , , , , , , ,P,P,2,2,2,3,3,X,X,X,X,X,X,X,X,X, , ,
 , , , , , , , , , , ,1,X, ,P,P,2,2,2,3,3,X,X,X,X,X,X,X,X,X,X,
 , , , , , , , , , , ,1,0, ,P,P,2,2,2,3,3,3,X,X,X,X,X,X,X,X,X,X
 , , , , , , , , , , ,1,X,2,2,P,2,2,2,2,2,3,X,X,X,X,X,X,X,X,X,X
 , , , , , , , , , , ,1,1,1,1,2,2,2,2,2,2,3,X,X,X,X,X,X,X,X,X,X
 , , , , , , , , , , ,1,1,1,1,2,2,2,2,2,2,2,2,X,X,X,X,X,X,X,X,X
 , , , , , , , , , , , , ,1,1,2,2,3,3,3,3,3,3,3,2,2,2,2,2,X,X,X
 , , , , , , , , , , , , ,1,1,2,2,3,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , , , , , , ,1,1,2,2,3,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , , , , , , ,1,1,2,2,2,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , , , , , , ,1,1,2,2,2,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , , , , , , ,2,1,1,2,2,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , ,2,2,2, , ,2,1,1,2,2,2,3,3,3,3,3,2,2,2,2,2,2,2,
 , , , , , , , ,2,2,2, , ,2,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,
```

Figure B-12 Priority Mask Message Format. (1 of 3)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
1	11	“Station”bXXX where “Station” = constant b = blank XXX = 3-letter station id, as defined in Table H-1	Station to which this message applies
2	17-20	“Effective Cycle”bnN where “Effective Cycle” = constant b = blank nN = 1-23	First cycle of the year on which this priority mask is to be applied Cycle 1 starts on January 1. (Don’t forget to include leap day as applicable.)
3	18-21	“Expiration Cycle”bnN where “Expiration Cycle” = constant b = blank nN = 1-23	Last cycle of the year on which this priority mask is to be applied Note that the last cycle (23) will always be less than 16 days. Cycle 23 always ends on December 31.
4	12-14	“Start Path”bPPP where “Start Path” = constant b = blank PPP = 1-233 (WRS path number)	WRS path number of the first entry in the mask. Equivalent to the upper-left corner of the Excel spreadsheet priority mask file distributed earlier in the program.
5	11-13	“Start Row”bRRR where “Start Row” = constant b = blank RRR = 1-248 (WRS row number)	WRS row number of the first entry in the mask. Equivalent to the upper-left corner of the Excel spreadsheet priority mask file distributed earlier in the program.

Figure B-12 Priority Mask Message Format. (2 of 3)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
6+	Variable	Comma delimited list of priority assignments Where "1" = priority 1 (high) "2" = priority 2 (medium) "3" = priority 3 (low) "X" = land scene not of interest "0" = flywheel scene over water "P" = PN downlinks over water " " = blank, either scene outside the acquisition circle, a water scene, or a scene not of interest	The list is representational of the WRS path/row matrix in the Excel spreadsheets distributed earlier in the program. The WRS paths are listed from west to east along the line; each line is one WRS row, starting from the north and going south. **Priority 1** = 160 scenes/cycle, As a general rule 10 per day (a slight modification can be negotiated with the MMO), across any three paths flown that day, one range per path, each range must be made up of contiguous scenes (e.g., a cluster of 3 scenes on first path and a cluster of 7 scenes on second); these scenes would be guaranteed to be acquired (99% or so). Any intervening flywheel water scenes must be included in the count of priority 1 scenes. **Priority 2** = 300 scenes/cycle, any unused priority 1 allocation can be added to this total, up to 460 scenes/cycle; more likely to be acquired than priority 3, not as failsafe as priority 1 acquisitions **Priority 3** = all other scenes in acquisition circle, for which requests are entered, that don't fall in the priority 1 or 2 categories; this is the default priority; will be acquired as resources permit, these will be the first scenes looked at for rejection if duty cycle is exceeded - remember that it takes 8 contiguous scenes to be deleted to make room for the first scene to be saved, thereafter it's a one-to-one relationship.

Figure B-12 Priority Mask Message Format. (3 of 3)

B.13 Priority/Service Request Mask File

The Priority/Service Request Mask (PSR) file is used by the IGS to submit either priority assignments or service requests. The second line in the file defines whether the contents refer to priorities or requests. The file format is the same as that generated by the IPM online tool for submission to the MOC. The message is a flat file representation of the path/row grid for the station acquisition circle. The message is generated at station start-up, placed on the MOC server via ftp, and is updated thereafter as required. Reasons for updating priorities may include changes in customer interest within the acquisition circle or addition/deletion of scenes from the circle. There are two alternative ways to submit priority masks: the IGS Priority & Request Map Editor (IPM) online tool, which is described in Appendix I; and the Priority Mask (PRI) message, which is described in Section B.12 and is the old file format. Use of the IPM tool or the PSR file is preferred over use of the PRI message. There are two alternative ways to submit requests: the IGS Priority & Request Map Editor (IPM) online tool, which is described in Appendix I; and the Service Request (REQ) message, which is described in Section B.3. Use of the IPM tool or the PSR file is preferred over use of the REQ message.

The Priority/Service Request Mask file specifies the cycles over which the mask is to be used. There may be as many 23 masks (one per 16-day cycle in a year) or one mask (applicable for the entire year). Masks are reapplied year after year unless updated. International Cooperators responsible for more than one station must submit separate masks for each station. Figure B-13 shows the format of the Priority/Service Request Mask file.

```
Station MPS
Priorities
Effective Cycle 1
Expiration Cycle 23
Start Path 219
Start Row 35
, , , , , , , , , , , , , ,P,P,2,2,2,3,3,X,X,X,X,X,X,X,X,X, ,
 , , , , , , , , , , ,1,X, ,P,P,2,2,2,3,3,X,X,X,X,X,X,X,X,X,
 , , , , , , , , , , ,1,0, ,P,P,2,2,2,3,3,3,X,X,X,X,X,X,X,X,X
 , , , , , , , , , , ,1,X,2,2,P,2,2,2,2,2,3,X,X,X,X,X,X,X,X,X
 , , , , , , , , , , ,1,1,1,1,2,2,2,2,2,2,3,X,X,X,X,X,X,X,X,X
 , , , , , , , , , , ,1,1,1,1,2,2,2,2,2,2,2,2,X,X,X,X,X,X,X,X
 , , , , , , , , , , , , ,1,1,2,2,3,3,3,3,3,3,3,2,2,2,2,2,X,X,X
 , , , , , , , , , , , , ,1,1,2,2,3,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , , , , , , ,1,1,2,2,3,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , , , , , , ,1,1,2,2,2,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , , , , , , ,1,1,2,2,2,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , , , , , , ,2,1,1,2,2,3,3,3,3,3,3,2,2,2,2,2,2,2,2
 , , , , , , , ,2,2,2, , ,2,1,1,2,2,2,3,3,3,3,3,2,2,2,2,2,2,2,
 , , , , , , , ,2,2,2, , ,2,1,1,2,2,2,2,2,2,2,2,2,2,2,2,2,2,2,
```

Figure B-13 Priority/Service Request Mask File Format, showing a submission of priority assignments. (1 of 4)

```
Station MPS
Requests
Effective Cycle 1
Expiration Cycle 23
Start Path 219
Start Row 35
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,1,0,1,1,0,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0
0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
0,0,0,0,0,0,0,0,1,1,1,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0
0,0,0,0,0,0,0,0,1,1,1,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0
```

Figure B-13 Priority/Service Request Mask File Format, showing a submission of service requests. (2 of 4)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
1	11	“Station”bXXX where “Station” = constant b = blank XXX = 3-letter station id, as defined in Table H-1	Station to which this message applies
2	8 or 10	"Priorities" or "Requests	Specifies the type of mask contained in the file -- priority assignment or service request.
3	17-20	“Effective Cycle”bnN where “Effective Cycle” = constant b = blank nN = 1-23	First cycle of the year on which this priority mask is to be applied Cycle 1 starts on January 1. (Don’t forget to include leap day as applicable.)
4	18-21	“Expiration Cycle”bnN where “Expiration Cycle” = constant b = blank nN = 1-23	Last cycle of the year on which this priority mask is to be applied Note that the last cycle (23) will always be less than 16 days. Cycle 23 always ends on December 31.
5	12-14	“Start Path”bPPP where “Start Path” = constant b = blank PPP = 1-233 (WRS path number)	WRS path number of the first entry in the mask. Equivalent to the upper-left corner of the Excel spreadsheet priority mask file distributed earlier in the program.
6	11-13	“Start Row”bRRR where “Start Row” = constant b = blank RRR = 1-248 (WRS row number)	WRS row number of the first entry in the mask. Equivalent to the upper-left corner of the Excel spreadsheet priority mask file distributed earlier in the program.

Figure B-13 Priority/Service Request Mask File Format. (3 of 4)

LINE NO.	NO. OF BYTES	FORMAT	DESCRIPTION
7+	Variable	If line 2 = "Priorities", then Comma delimited list of priority assignments Where "1" = priority 1 (high) "2" = priority 2 (medium) "3" = priority 3 (low) "X" = land scene not of interest "0" = flywheel scene over water "P" = PN downlinks over water " " = blank, either scene outside the acquisition circle, a water scene, or a scene not of interest If line 2 = "Requests", then Comma delimited list of service requests Where "1" = scene requested for downlink "0" = scene not requested for downlink	For Priorities: The list is representational of the WRS path/row matrix in the Excel spreadsheets distributed earlier in the program. The WRS paths are listed from west to east along the line; each line is one WRS row, starting from the north and going south. **Priority 1** = 160 scenes/cycle, As a general rule 10 per day (a slight modification can be negotiated with the MMO), across any three paths flown that day, one range per path, each range must be made up of contiguous scenes (e.g., a cluster of 3 scenes on first path and a cluster of 7 scenes on second); these scenes would be guaranteed to be acquired (99% or so). Any intervening flywheel water scenes must be included in the count of priority 1 scenes. **Priority 2** = 300 scenes/cycle, any unused priority 1 allocation can be added to this total, up to 460 scenes/cycle; more likely to be acquired than priority 3, not as failsafe as priority 1 acquisitions **Priority 3** = all other scenes in acquisition circle, for which requests are entered, that don't fall in the priority 1 or 2 categories; this is the default priority; will be acquired as resources permit, these will be the first scenes looked at for rejection if duty cycle is exceeded - remember that it takes 8 contiguous scenes to be deleted to make room for the first scene to be saved, thereafter it's a one-to-one relationship.

Figure B-13 Priority/Service Request Mask File Format. (4 of 4)

Appendix C X-Band Communications Link Interface Characteristics

C.1 Link Functional Design

During the period that Radio Frequency (RF) line-of-sight conditions exist between the Landsat 7 satellite and the IGS, wideband science data is downlinked to the IGS through the use of the gimbaled X-band antennas (GXAs) as scheduled by the MOC. Link operation is dependent upon RF line-of-sight conditions between the satellite and the IGS, and the IGS antenna local elevation angle being greater than 5 degrees and above the local mask. Accessibility for signal acquisition purposes is not precluded by the satellite for IGS antenna local elevation angles greater than 1 degree. The maximum expected Doppler is less than 190 kHz.

The interface links between the IGS and the satellite are:

- 8082.5 MHz (Low Frequency)
- 8212.5 MHz (Mid Frequency)
- 8342.5 MHz (High Frequency)

Transmission from the satellite to IGS of real-time science data from the ETM+ payload is at a data rate of 150 Mbps. The ETM+ payload data consists of ETM+ payload imagery, calibration data, and payload correction data (PCD). Each 150 Mbps link consists of two 75 Mbps data streams which are modulated on the In-phase (I) and Quadrature (Q) channels.

The functional interface of this link is shown in Figure C-1. Real-time ETM+ payload data is provided by the baseband switching unit (BSU) for routing to the appropriate X-band transmitters. The 75 Mbps (74.914 Mbps ± 0.00075 Mbps) I and Q channel data streams from the BSU are input to the appropriate X-band transmitter. Within the X-band transmitter, data from the BSU is input to the baseband driver which reclocks the incoming Non Return to Zero Level (NRZ-L) data and drives the Quadrature Phase Shift Keying (QPSK) modulator. I and Q channel data from the baseband driver is QPSK modulated onto the X-band carrier with an I/Q channel power ratio of 1:1, as shown in Figure C-2. No attempt is made onboard the satellite to synchronize the bit transitions on the I and Q channels, and they must therefore be treated as Asynchronous QPSK (AQPSK). The transmit carrier is derived from a Phase Locked Dielectric Resonator Oscillator (PL-DRO). The output of the QPSK modulator is input to a solid state power amplifier (SSPA) within the X-band transmitter that amplifies the AQPSK modulated signal to provide the necessary output power. The amplified AQPSK modulated signal is transmitted at the appropriate carrier frequency and sent through a triplexer which bandwidth limits the signal to a 112.5 MHz (3 dB) bandwidth. The signal is routed to the IGS via a right-hand circular (RHC) GXA.

Within the IGS, the input signal from the receive antenna is downconverted before being input to the QPSK receiver/demodulator. The QPSK receiver/demodulator demodulates the downconverted AQPSK signal into separate I and Q channel data streams with NRZ-L format.

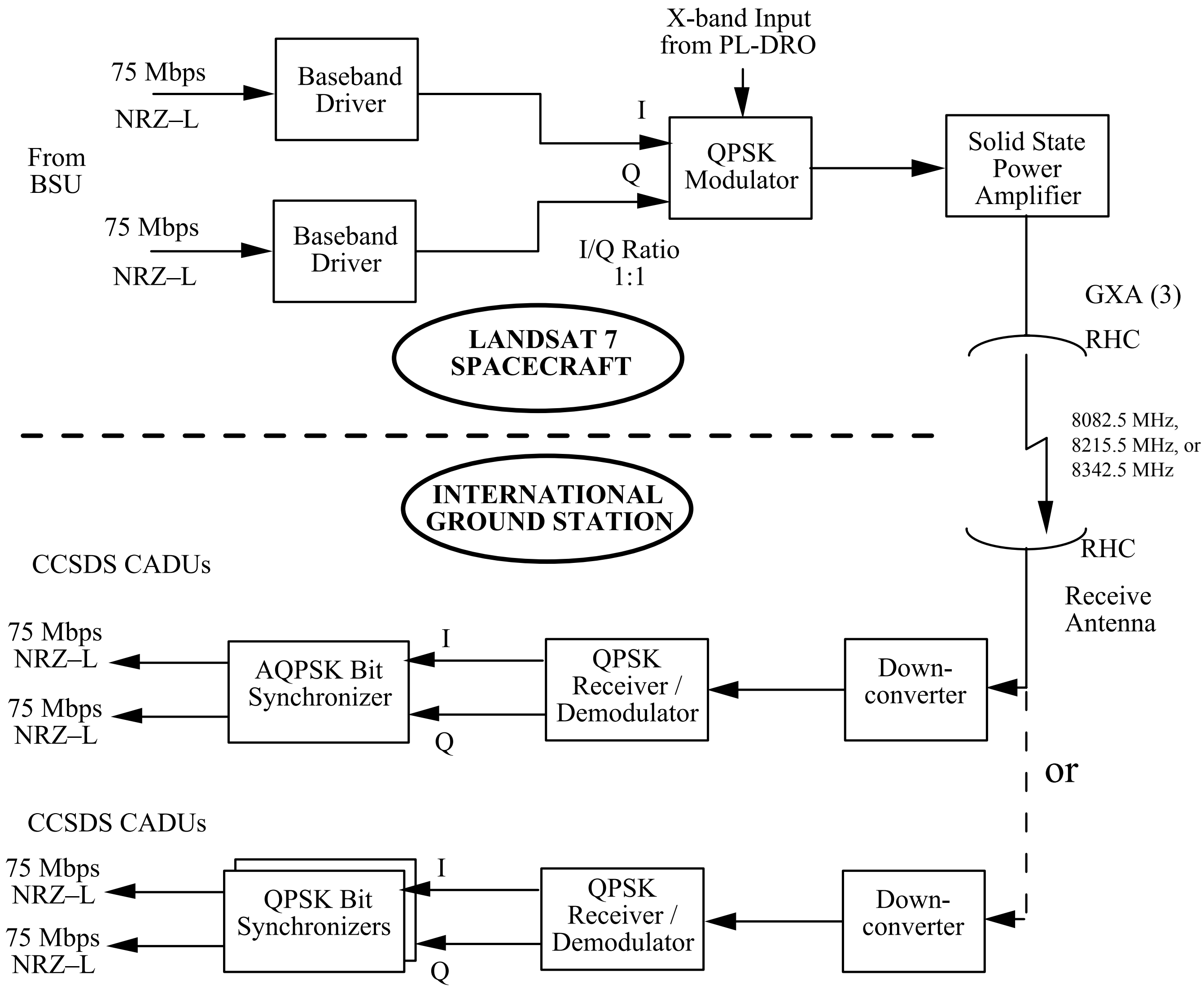


Figure C-1 Landsat 7 to IGS X-Band Downlink Configuration

Following QPSK demodulation, the bit synchronizer provides I and Q channel data clock recovery. Separate clock recovery circuits must be provided for the I and Q channels, either by using two independent bit synchronizers or one bit synchronizer which internally generates two independent clocks. The outputs (data and clock) from the bit synchronizer(s) are provided for data storage.

C.2 Baseband Signal Characteristics

The science data baseband signal in the satellite is an NRZ-L waveform. All Landsat 7 science data is formatted for transmission at 150 Mbps over the X-band link. With the exception of pseudorandom noise (PN) fill data, the delivery service is equivalent to the Grade 3 service defined in Consultative Committee for Space Data Systems (CCSDS) 701.0-B-1, Advanced Orbiting Systems, Networks and Data Links: Architectural Specification. The downlink transfer frame format is depicted in Figure C-3. PN fill data will not be structured in CCSDS Channel Access Data Units (CADUs).

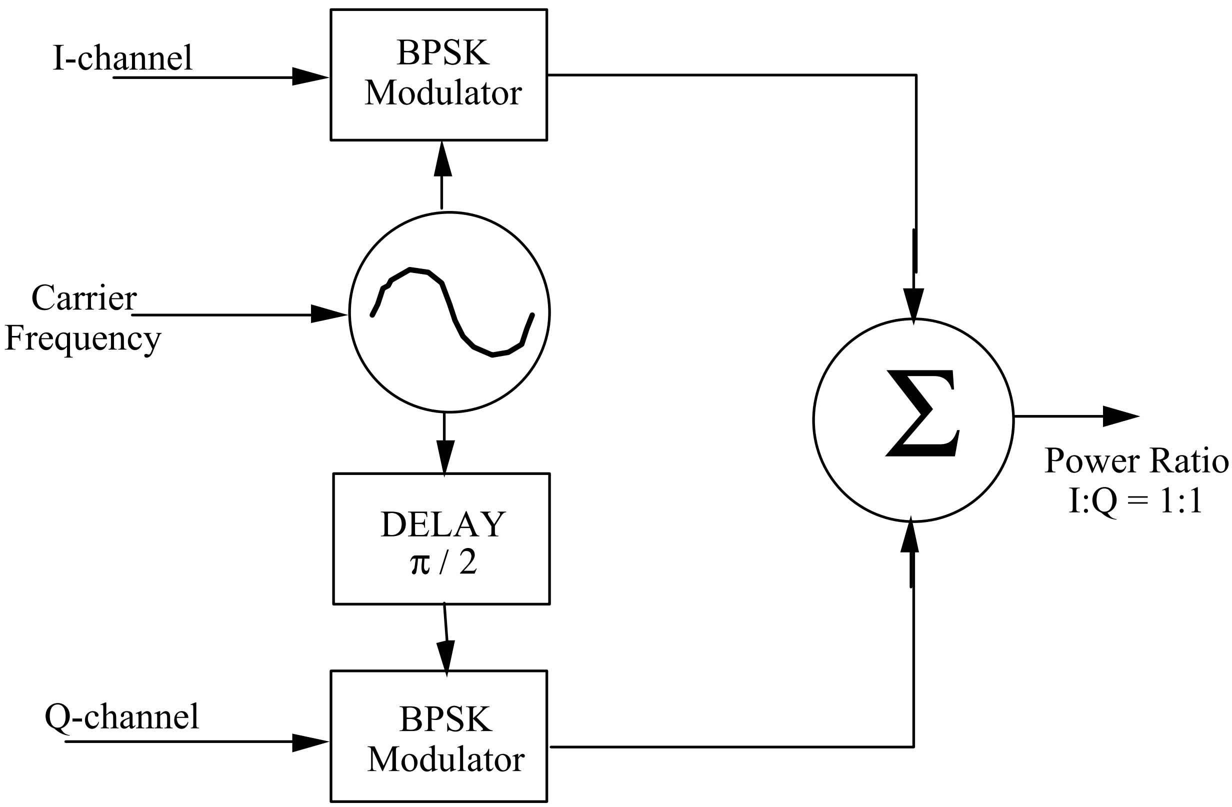


Figure C-2 X-Band Downlink Modulation Functional Configuration.

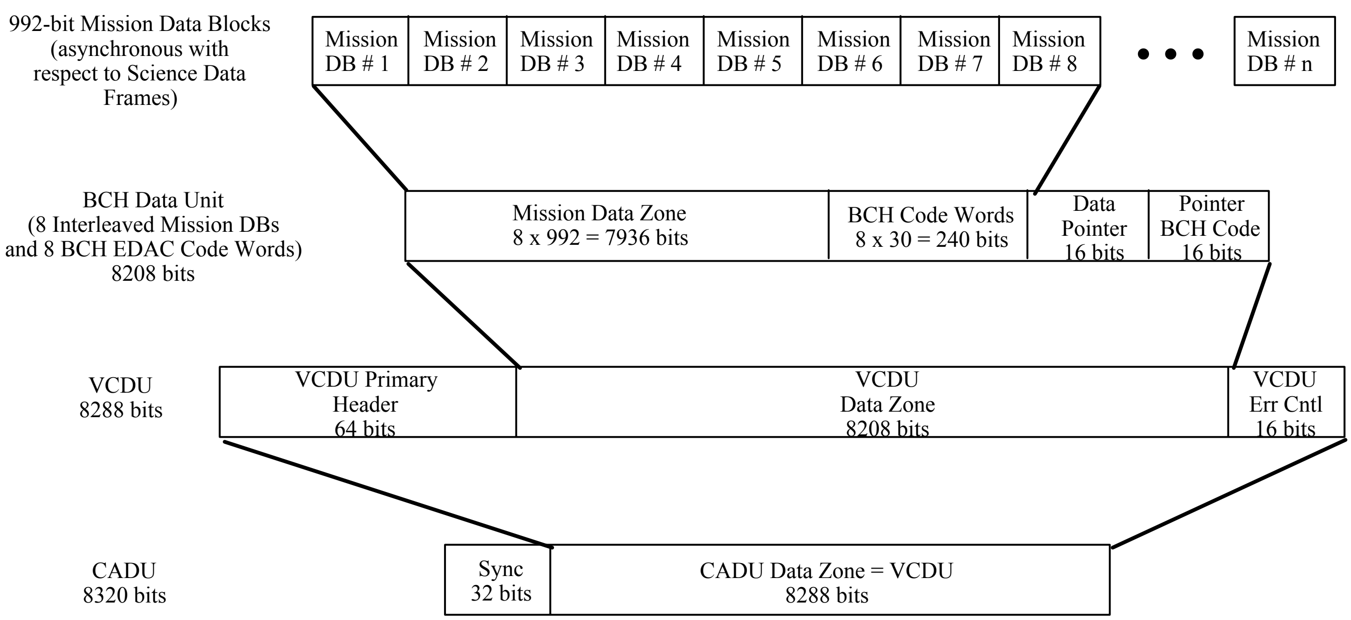


Figure C-3 X-Band Channel Access Data Unit (Sync + Virtual Channel Data Unit).

Data is formatted by the ETM+ payload into separate mission data streams that are provided as a single bit stream for Bose–Chaudhuri–Hocquenghem (BCH) encoding. Data streams consist of 992 bit data blocks of payload data. Data blocks are segmented into a BCH data unit that contains a predefined data zone of 7936 bits, a BCH error detection and correction (EDAC), data pointer, and data pointer error control field. Each BCH data unit is encapsulated in a Virtual Channel Data Unit (VCDU) which contains a VCDU header, data zone, and VCDU error control field. Data is transmitted serially in CCSDS Channel Access Data Units (CADUs) which encapsulate the VCDUs.

The X-band direct downlink data has a (1023,993,3) BCH code with interleave depth I=8. The BCH encoder output is 1023 bits (for each input data block of 993 bits). The input consists of 992 bits of science data and one fill bit. Only the 992 bits of science data are transmitted to the ground. The fill bit ("0") is added, on the ground, prior to decoding. The error correction code word corresponding to each input data block has a length of 30 bits. The code corrects up to three bit errors per block. The (1023,993,3) BCH encoder is shown in Figure C-4. Figure C-3 shows the organization of BCH data blocks and code words within each BCH data unit. Through the application of a BCH error correction code to the science data, the real-time ETM+ payload science data has a bit error rate (BER) of < 10^{-6}. If the IGS does not provide BCH decoding, the data will have a BER of 10^{-5} at the ground station interface.

A given bit synchronizer may receive either the I or Q channel, in either normal or inverted form. The IGS should search for the 32-bit synch pattern in both normal and inverted form. This should be done independently for each channel. Then the virtual channel identifier (VCID) in the VCDU header of each channel should be inspected to determine whether the data is Format 1 or Format 2.

C.3 RF Signal Characteristics

During pre-launch spacecraft-level testing, the I/Q ratio measured from X-band transmitter Mid Frequency #2 (M2) was -1.20 dB, which is below the specification of 0 dB ± 0.8 dB. A waiver was requested and approved to allow the M2 transmitter I/Q ratio to be judged acceptable within the range of 0 dB ± 1.4 dB. (The additional 0.2 dB allows for test equipment repeatability/accuracy and additional small changes during thermal environments.) This is reflected in the link budget for the Mid frequency in Table C-2.

The X-band transmitter uses a single fixed frequency reference. The frequency reference source is a Phased Locked Dielectric Resonator Oscillator (PL–DRO).

The satellite is required to close the link for an IGS receive system performance (G/T) greater than or equal to 30.4 dB/K during a rain rate of 4 mm/hr at a 5 degree local elevation angle. The satellite is required to provide the capability to transmit each 150 Mbps X-band downlink with a minimum 24.2 dBW effective isotropic radiated power (EIRP) in the direction of the IGS.

Balanced QPSK modulation (channel power ratio of 1:1 ± 0.8 dB) is used, as shown in Figure C-2. The X-band carrier is modulated by the I and Q baseband signals.

C.4 Link Budgets

Tables C-1 through C-3 show the link budgets for the Landsat 7 to IGS downlinks at each of the three available frequencies.

The additional I/Q imbalance described in C.3 doesn't affect spacecraft hardware reliability or long term performance, but it does affect space to ground link performance and possibly the ground station demodulator performance. A review of the LGS and Lockheed Martin demodulators revealed that the technique being used for carrier estimation will not be measurably affected by this amount of additional I/Q imbalance. The demodulator vendor, Scientific Atlanta, confirmed this conclusion. The effect on the space ground link will be the result of one channel being lower in power than the other. At the ground station, this will translate into a lower E_b/N_0 and therefore a higher bit error rate (BER). As the link performance already contains sufficient margin such that the additional degradation still yields better than required BER, the out of spec I/Q ratio is not significant. The current link budget shows worst case excess link margin (over and above the required 3 dB margin) of 0.33 dB. With this change, the worst case excess link margin would be reduced from 0.33 dB to 0.03 dB. With the 3 dB margin already required by the link budget, better than required link BER performance is still assured. If additional factors such as transmitter power and cable losses that have been measured to be better than the specification requirements were taken into account, the excess margin would increase by another 2 dB.

C.5 Antenna Characteristics

The actual radiation pattern of one of the three X-band flight antennas, at each of the three frequencies, is given in Figures C-5 through C-7. These patterns were used to verify that the beamwidth, gain, and sidelobes of the antennas met the specified system requirements.

Generator polynomial $g(x) = x^{30} + x^{28} + x^{23} + x^{21} + x^{19} + x^{16} + x^{12} + x^{8} + x^{4} + x + 1$

Number of error control bits = 30

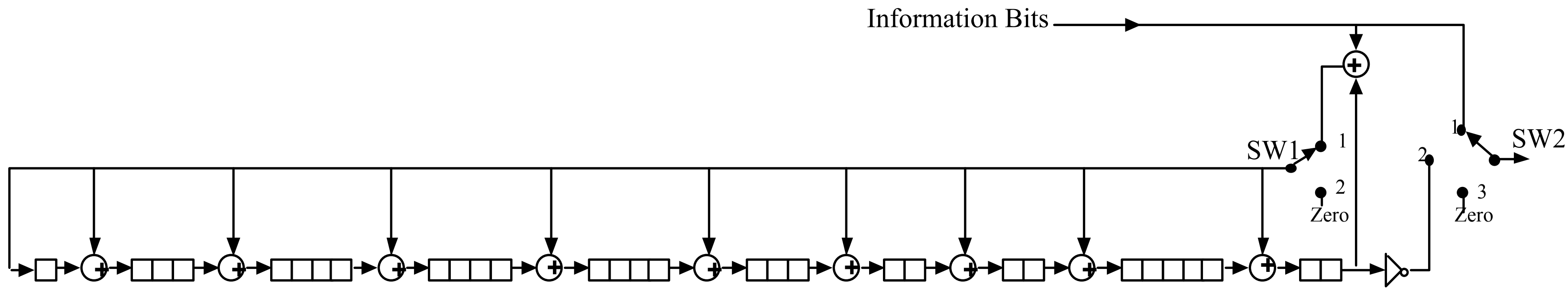


Figure C-4 (1023,993,3) BCH Code Generator – X-Band Science Data

Carrier Frequency (MHz) 8342.5 (150 Mbps)

PARAMETER	VALUE	COMMENTS
EIRP (dBW) Transmit Power (dBW) Passive Loss (dB) Antenna Gain (dBi) Pointing Loss (dB)	24.20 5.40 –6.90 26.20 –0.50	Landsat 7 System requirement
Modulation Loss (dB)	–0.40	1:1 I/Q ratio with ± 0.8 dB
Space Loss (dB)	–179.08	range = 2575 km, 5 degrees elevation
Polarization Loss (dB)	–0.35	AR (LS7) = 3.5, AR (IGS) = 1.5
Scintillation Loss	–1.00	Estimate based on Sioux Falls antenna
Propagation Loss (dB) Rain Attenuation (dB) Atmospheric Loss (dB)	–1.82 –1.13 –0.69	 4 mm/hr, 5 degrees elevation, Sioux Falls 28°C, 70% relative humidity
Receive G/T (dB/K) Clear Sky G/T (dB/K) T Increase due to Rain	30.40 32.30 –1.90	Landsat 7 System requirement Based on 9–meter antenna with 185 K Increase of 101 K
Pointing Loss - IGS (dB)	–0.50	Estimate based on Sioux Falls antenna
Boltzmann Constant (dBW/Hz-K)	–228.60	
Received C/N_0 (dB-Hz)	100.05	
Noise Bandwidth (dB-Hz)	81.76	150 Mbps
Link E_b/N_0 (dB)	18.29	
Implementation Loss (dB)	–5.50	Estimate based on simulation
Required E_b/N_0 (dB)	9.60	BER 1e-5, theory (NRZ-L)
Available Signal Margin (dB)	3.19	
Required Signal Margin (dB)	3.00	Landsat 7 System requirement
Excess Signal Margin (dB)	0.19	

Table C-1 Link Budget for X-Band High Frequency.

Carrier Frequency (MHz) 8212.5 (150 Mbps)

PARAMETER	VALUE	COMMENTS
EIRP (dBW) Transmit Power (dBW) Passive Loss (dB) Antenna Gain (dBi) Pointing Loss (dB)	24.20 5.40 –6.90 26.20 –0.50	Landsat 7 System requirement
Modulation Loss (dB)	–0.70	1:1 I/Q ratio with ± 1.4 dB
Space Loss (dB)	–178.95	range = 2575 km, 5 degrees elevation
Polarization Loss (dB)	–0.35	AR (LS7) = 3.5, AR (IGS) = 1.5
Scintillation Loss	–1.00	Estimate based on Sioux Falls antenna
Propagation Loss (dB) Rain Attenuation (dB) Atmospheric Loss (dB)	–1.82 –1.13 –0.69	 4 mm/hr, 5 degrees elevation, Sioux Falls 28°C, 70% relative humidity
Receive G/T (dB/K) Clear Sky G/T (dB/K) T Increase due to Rain	30.40 32.30 –1.90	Landsat 7 System requirement Based on 9 m antenna with 185 K Increase of 101 K
Pointing Loss - IGS (dB)	–0.50	Estimate based on Sioux Falls antenna
Boltzmann Constant (dBW/Hz-K)	–228.60	
Received C/N_0 (dB-Hz)	100.18	
Noise Bandwidth (dB-Hz)	81.76	150 Mbps
Link E_b/N_0 (dB)	18.43	
Implementation Loss (dB)	–5.50	Estimate based on simulation
Required E_b/N_0 (dB)	9.60	BER 1e-5, theory (NRZ-L)
Available Signal Margin (dB)	3.03	
Required Signal Margin (dB)	3.00	Landsat 7 System requirement
Excess Signal Margin (dB)	0.03	

Table C-2 Link Budget for X-Band Mid Frequency.

Carrier Frequency (MHz) 8082.5 (150 Mbps)

PARAMETER	VALUE	COMMENTS
EIRP (dBW) Transmit Power (dBW) Passive Loss (dB) Antenna Gain (dBi) Pointing Loss (dB)	24.20 5.40 –6.90 26.20 –0.50	Landsat 7 System requirement
Modulation Loss (dB)	–0.40	1:1 I/Q ratio with ± 0.8 dB
Space Loss (dB)	–178.81	range = 2575 km, 5 degrees elevation
Polarization Loss (dB)	–0.35	AR (LS7) = 3.5, AR (IGS) = 1.5
Scintillation Loss	–1.00	Estimate based on Sioux Falls antenna
Propagation Loss (dB) Rain Attenuation (dB) Atmospheric Loss (dB)	–1.82 –1.13 –0.69	 4 mm/hr, 5 degrees elevation, Sioux Falls 28°C, 70% relative humidity
Receive G/T (dB/K) Clear Sky G/T (dB/K) T Increase due to Rain	30.40 32.30 –1.90	Landsat 7 System requirement Based on 9 m antenna with 185 K Increase of 101 K
Pointing Loss - IGS (dB)	–0.50	Estimate based on Sioux Falls antenna
Boltzmann Constant (dBW/Hz-K)	–228.60	
Received C/N_0 (dB-Hz)	100.32	
Noise Bandwidth (dB-Hz)	81.76	150 Mbps
Link E_b/N_0 (dB)	18.57	
Implementation Loss (dB)	–5.50	Estimate based on simulation
Required E_b/N_0 (dB)	9.60	BER 1e-5, theory (NRZ-L)
Available Signal Margin (dB)	3.47	
Required Signal Margin (dB)	3.00	Landsat 7 System requirement
Excess Signal Margin (dB)	0.47	

Table C-3 Link Budget for X-Band Low Frequency.

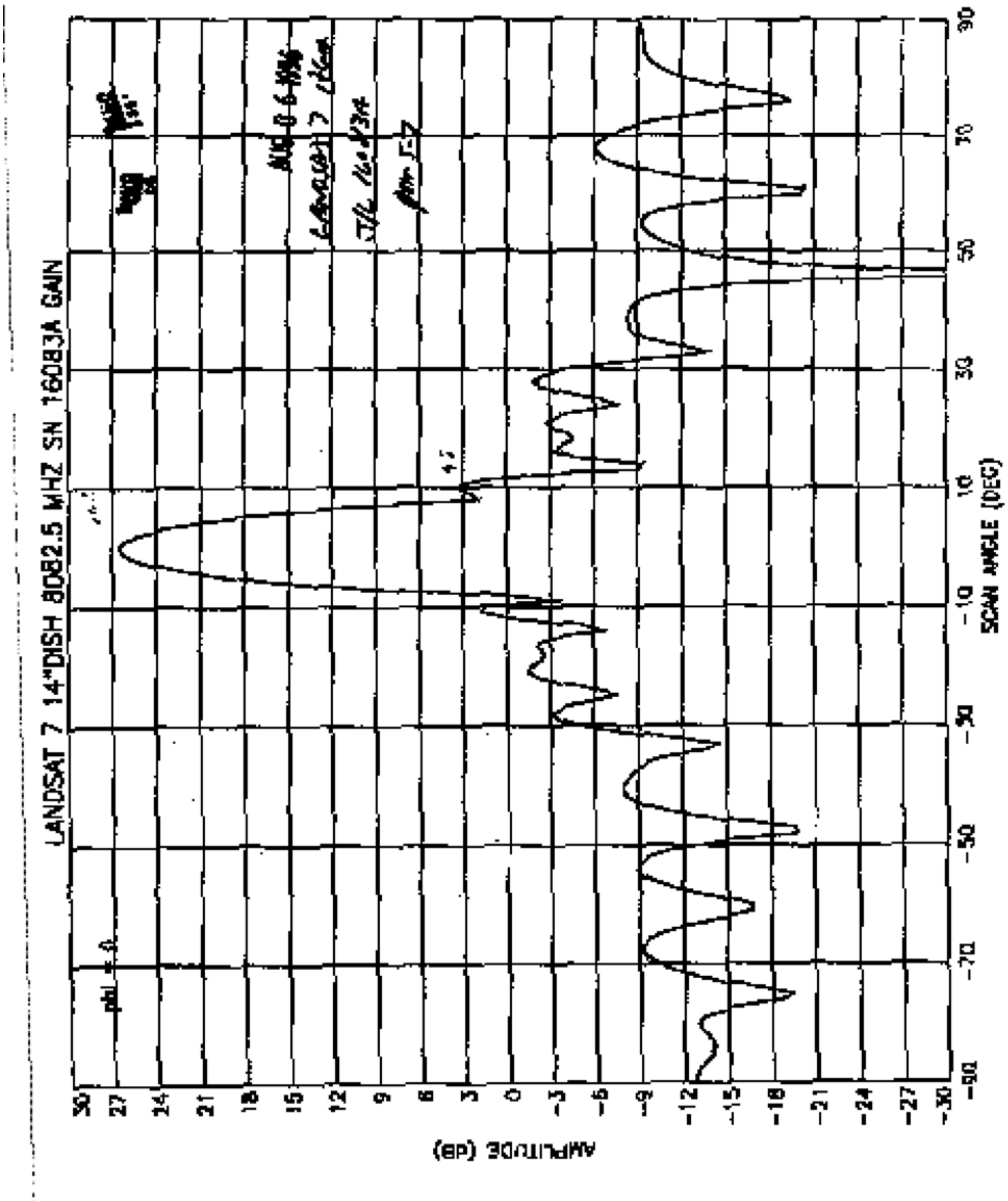


Figure C-5 Actual Radiation Pattern for Gimbaled X-band Antenna at Low Frequency.

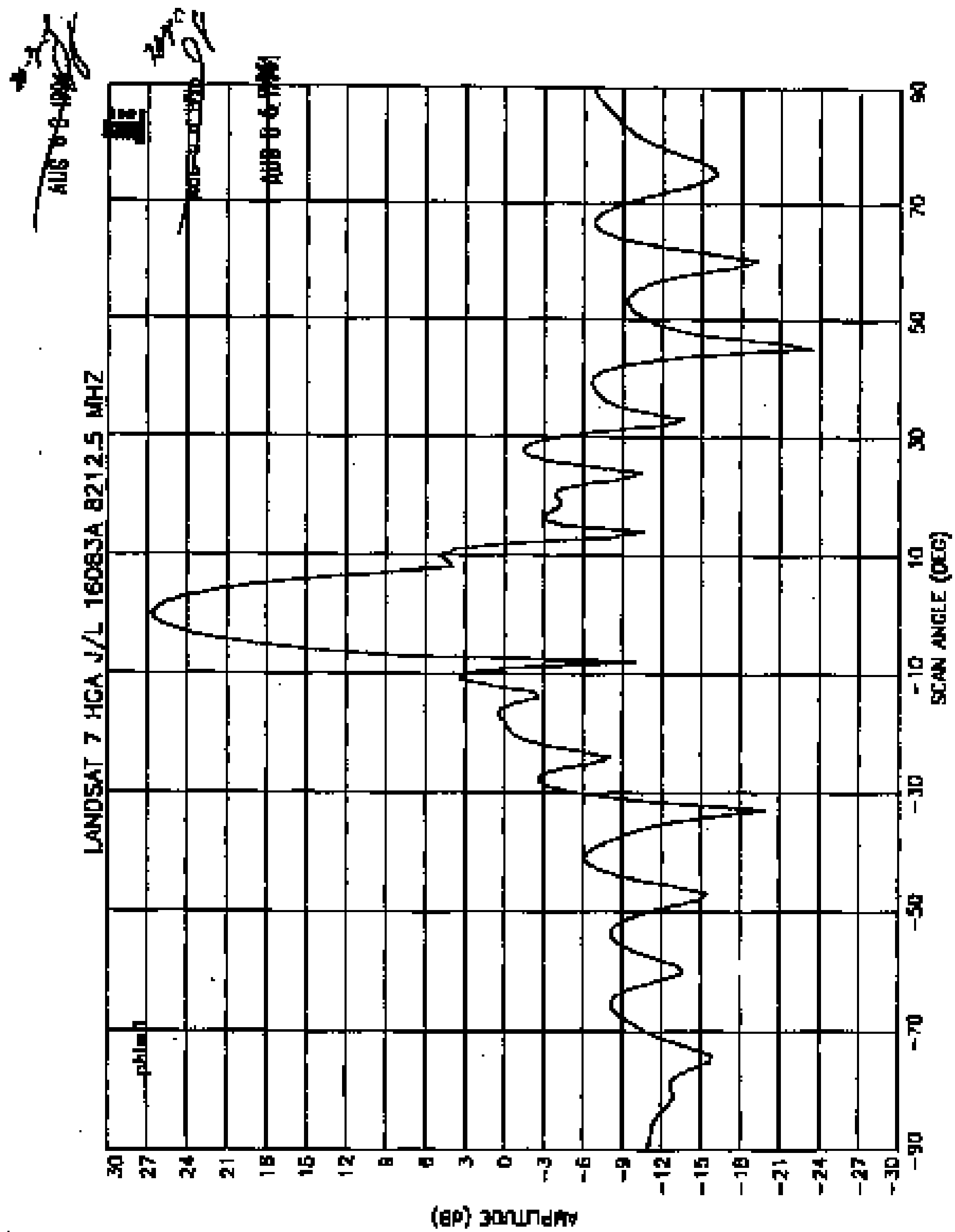


Figure C-6 Actual Radiation Pattern for Gimbaled X-band Antenna at Mid Frequency.

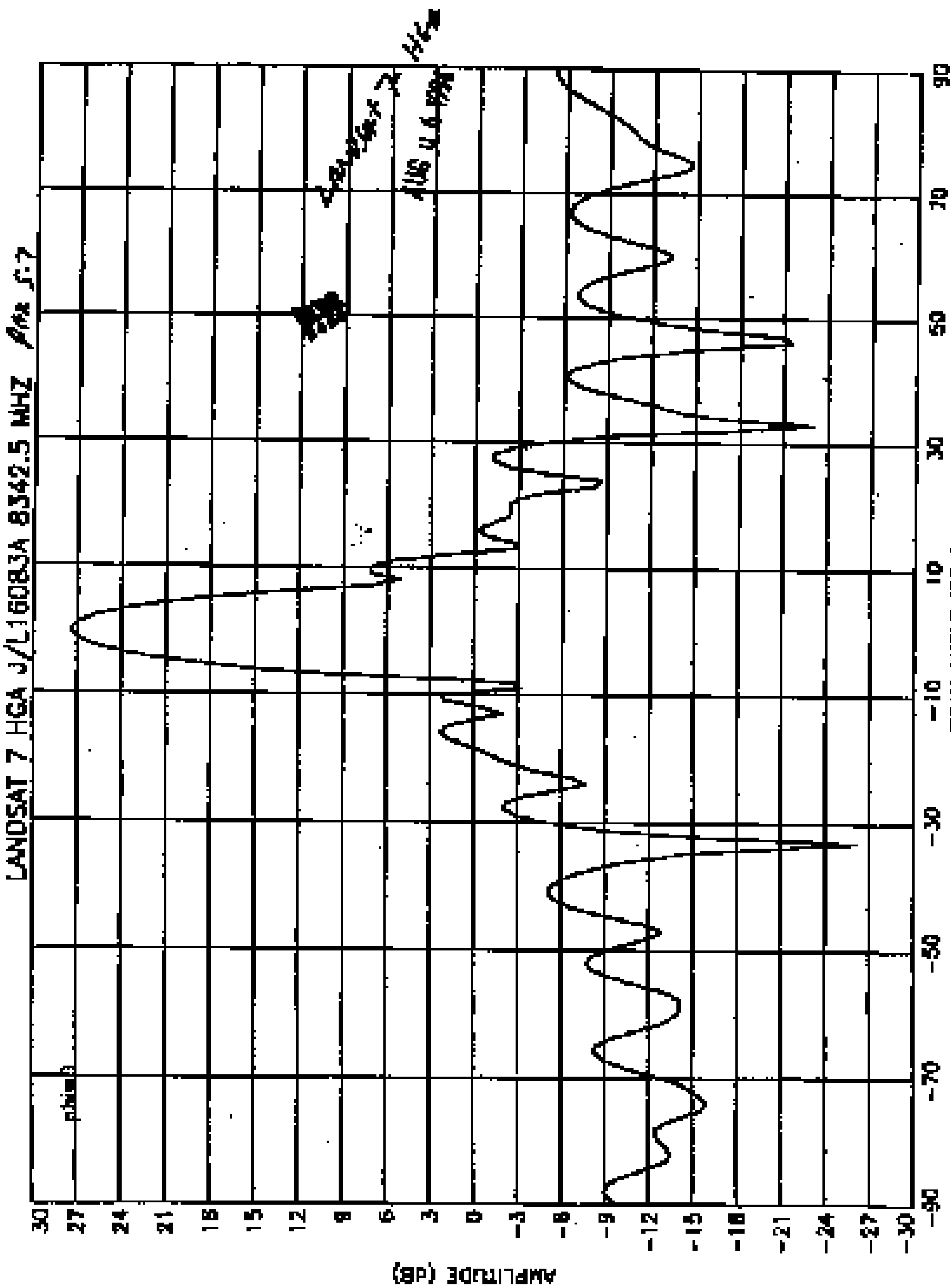


Figure C-7 Actual Radiation Pattern for Gimbaled X-band Antenna at High Frequency.

Appendix D Metadata Format

The metadata file is written in Object Description Language (ODL), which is a text-based language. The ODL conventions are discussed in D.1. The format of the metadata is specified in D.2, along with an example of the metadata file. The algorithm used to calculate the scene quality parameter in the metadata is presented in D.3. The transfer of metadata from the IGS to the DAAC is described in Appendix F.

D.1 Object Description Language (ODL)

The metadata file format conforms to the Object Description Language (ODL) standard. Details on the ODL standard are provided in the Planetary Data System Standards Reference document (Reference Document 5). In accordance with the ODL standard, all parameters and values are presented using ASCII standard characters.

The following notes apply to the construction of metadata statements:

1. Metadata definition is in the form of Parameter = Value.
2. There is one Parameter definition per line.
3. Blank spaces and lines are ignored.
4. Each line of comments must begin with the characters /* and end with the characters */, including comments embedded on the same line as a Parameter definition.
5. Leading zeros are recommended throughout for consistency, but not required except as follows:
   - parameters associated with WRS path and row (e.g., WRS_PATH and WRS_ROW)
   - in the metadata GROUP and END_GROUP statements that include a multiple digit field (e.g., METADATA_SCENE_nn)
   - in the SCENE_QUALITY parameter, for positive values only
6. All absolute character strings, including single character strings such as "+", "-", "Y", and "N" characters, are enclosed with quotes (" "). The exceptions to this rule are the GROUP and END_GROUP Values, which do not use quotation marks.
7. All values equal to or greater than zero (0) are considered positive. All values less than zero (0) are considered negative.
8. Case is not significant, but upper case is recommended for Parameters for readability.
9. Indentation is not significant, but is recommended for readability.
10. Bolding and capitalization of group names is used purely for readability.
11. Only the basic ASCII character set may be used.

D.2 Metadata Format

Figure D-1 describes the structure of the metadata file. (The dots in Figure D-1 are for illustrative purposes only – to highlight the file hierarchy – and are not a part of the format.) Within each file, there are five different ODL groups defined:

1. METADATA_FILE — this group encompasses the entire file and identifies it as a metadata file; it is a shell and is immediately followed by the METADATA_FILE_INFO header; there is one of this group per file
2. METADATA_FILE_INFO — this group is the file header and identifies the file name, creation date, version, and station; there is one of this group per file

3. SUBINTERVAL_METADATA_FMT_n — this group defines the subinterval in terms of satellite, sensor, path/row, latitude/longitude, and band state; it brackets the scene metadata groups for the specified format; there is one of this group for each format in the file
4. METADATA_SCENE_nn — this group is a shell for the scene-level metadata (the Landsat Processing System (LPS) inserts Parameters in this group, but none are required in IGS files) and is followed immediately by the WRS_SCENE_nn group header; there is one of this group for each scene (including partial scenes) in the subinterval
5. WRS_SCENE_nn -- this group defines each scene (including partial scenes) in the subinterval, including path/row, scene center time, latitude/longitude, quality, gain settings and associated browse file name; there is one of this group for each scene (including partial scenes) in the subinterval

A single metadata file describes a single subinterval, both Format 1 and Format 2. The Format 1 metadata group (SUBINTERVAL_METADATA_FMT_1) contains subinterval level and WRS scene level metadata for Bands 1–6. The Format 2 metadata group (SUBINTERVAL_ METADATA_FMT_2) contains subinterval level and WRS scene level metadata for Bands 6–8. The multiband-scene browse file names and the Automated Cloud Cover Assessment (ACCA) results are provided in the Format 1 (Bands 1–6) subinterval metadata only. They must be present in the Format 1 metadata but may be repeated in the Format 2 metadata if desired by the IGS.

Table D-1 provides details for constructing the metadata file. It specifies the following for each field in the metadata format: Parameter name, size (in ASCII bytes), value, format, range and units, and parameter description/remarks. All parameters are required fields, unless the word "OPTIONAL" appears in the parameter description/remarks column of Table D-1. Any references in the Remarks or Value columns about how the LPS derives the data are for information purposes only and not intended to direct IGS implementation.

Figure D-2 is an example of a metadata file. The use of group definitions, syntax, comments, quotation marks, indentation and case is consistent with the guidelines listed above. Sample values are given to illustrate the formatting of the Value field. The comments enclosed in "/*...*/" are not explicitly required in the implemented metadata file format; they are shown to clarify the metadata format construction. GROUP statements are presented in bold in this ICD only for readability. (Bolding these statements is not required in the metadata implementation.)

```
                /*  FORMAT STRUCTURE FOR IGS-PROVIDED LANDSAT 7 METADATA */

GROUP = METADATA_FILE          /*   first declaration of every metadata file   */
.
.   GROUP = METADATA_FILE_INFO      /*   second declaration of every metadata file  */
.   .          file name, creation date, version, and station id go here
.   END_GROUP = METADATA_FILE_INFO             /*   closes the file header group   */
.
.   GROUP = SUBINTERVAL_METADATA_FMT_1        /* descr. of fmt 1 subinterval */
.   .          Satellite, sensor, path/rows, subinterval corner latitude and longitudes go here
.   .
.   .   GROUP = METADATA_SCENE_01     /*   starts description of first scene   */
.   .   .   GROUP = WRS_SCENE_01
.   .   .   .          Metadata for scene 1 of Format 1's subinterval
.   .   .   END_GROUP = WRS_SCENE_01
.   .   END_GROUP = METADATA_SCENE_01            /*   closes the first scene group   */
.   .          •                   •
.   .          •                   •
.   .          •                   •
.   .   GROUP = METADATA_SCENE_nn /*   description of format 1 last scene   */
.   .   .   GROUP = WRS_SCENE_nn
.   .   .   .          Metadata for last scene of Format 1's subinterval
.   .   .   .          nn = sequence number of last scene in Format 1 subinterval
.   .   .   END_GROUP = WRS_SCENE_nn
.   .   END_GROUP = METADATA_SCENE_nn                /*   closes the last scene group   */
.   .
.   END_GROUP = SUBINTERVAL_METADATA_FMT_1      /*closes format 1 subinterval descr.*/
.
.   GROUP = SUBINTERVAL_METADATA_FMT_2            /* descr. of fmt 2 subinterval */
.   .          Satellite, sensor, path/rows, subinterval corner latitude and longitudes go here
.   .
.   .   GROUP = METADATA_SCENE_01     /*   starts description of first scene   */
.   .   .   GROUP = WRS_SCENE_01
.   .   .   .          Metadata for scene 1 of Format 2's subinterval
.   .   .   END_GROUP = WRS_SCENE_01
.   .   END_GROUP = METADATA_SCENE_01            /*   closes the first scene group   */
.   .          •                   •
.   .          •                   •
.   .          •                   •
.   .   GROUP = METADATA_SCENE_nn /*   description of format 2 last scene   */
.   .   .   GROUP = WRS_SCENE_nn
.   .   .   .          Metadata for last scene of Format 2's subinterval
.   .   .   .          nn = sequence number of last scene in Format 2 subinterval
.   .   .   END_GROUP = WRS_SCENE_nn
.   .   END_GROUP = METADATA_SCENE_nn                /*   closes the last scene group   */
.   .
.   END_GROUP = SUBINTERVAL_METADATA_FMT_2      /*closes format 2 subinterval descr.*/
.   .
END_GROUP = METADATA_FILE
END                                            /*   last declaration of every metadata file   */
```

Figure D-1 IGS Metadata Format Structure.

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
GROUP	13	= METADATA_FILE	First declaration of every metadata file. It identifies the file as a metadata file.
GROUP	18	= METADATA_FILE_INFO	Indicates the start of the metadata file information group records.
FILE_NAME	24	= "L7xxxppprrryyyymmddf.MTA" where: "L7" = constant (Landsat 7) xxx= station id code in upper-case letters (ref. Table H-1) ppp = WRS Path of first scene rrr = WRS Row of first scene yyyy = 4-digit Year of acquisition mm = Month (01-12) dd = Day (01-31) f = format in file (0 for both) ".MTA" = constant (metadata file)	This field is a file name for all the metadata records for a particular subinterval. This convention creates a unique file name for each subinterval metadata file.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (1 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
FILE_CREATION_DATE_TIME	20	= yyyy-mm-ddThh:mm:ssZ where: yyyy = 4-digit Year of creation (e.g., 1998 or 2001) "-" = date field separator mm = Month (01-12 for January to December) "-" = date field separator dd = Day (01-31) "T" = constant (start of time information in ODL ASCII time code format) hh = Hour (00 - 23) ":" = time field separator mm = Minutes (00-59) ":" = time field separator ss = Seconds (00 - 59) "Z" = constant (Zulu time - same as GMT)	This field specifies the date and time the metadata file was created. For ease of human readability, this date and time information is presented in the ODL ASCII format. The time is expressed as Coordinated Universal Time (UTC) - also known as Greenwich Mean Time (GMT) or Zulu time. Insertion of characters "T" and "Z" is required to meet the ODL ASCII time format.
FILE_VERSION_NO	1	= 0-9 where: 0 = new file, 1-9 = the file replacement count	Field to distinguish a later file from an earlier file for the same subinterval previously sent to the LP DAAC.
STATION_ID	3	= "sss" sss = 3-letter station id in upper-case letters; see Table H-1 for valid values	ID of Landsat ground station that produced the metadata

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (2 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
END_GROUP	18	= METADATA_FILE_INFO	Indicates the end of the metadata file information group records
Start of Subinterval Level Metadata			
GROUP	26	= SUBINTERVAL_METADATA_FMT_1	Indicates the start of the Format 1 subinterval level metadata group records
SPACECRAFT_ID	8	= "Landsat7"	Name of satellite
SENSOR_ID	4	= "ETM+"	Sensor that acquired the data
STARTING_PATH	3	= 001 - 233 (Leading zeros are required)	The WRS path number for the scenes included in this subinterval.
STARTING_ROW	3	= 001 - 248 (Leading zeros are required)	The starting WRS row number for the scene data included in this subinterval.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (3 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
ENDING_ROW	3	= 001 - 248 (Leading zeros are required)	The ending WRS row number for the scene data included in this subinterval.
TOTAL_WRS_SCENES	1-2	= 1 - 99	The total number of scenes (including partial scenes) that are in this subinterval. The LPS produces this count from the total number of WRS scenes identified in a subinterval. The LPS does not use the absolute difference between STARTING_ROW and ENDING_ROW + 1 to compute this count.
SUBINTERVAL_START_TIME	18	= yyyy-dddThh:mm:ssZ where: yyyy = 4-digit year "-" = date field separator ddd = Day of year (001 - 366) "T" = constant hh = Hours (00 - 23) ":" = time field separator mm = Minutes (00 - 59) ":" = time field separator ss = Seconds (00 - 59) "Z" = constant	The time associated with the start of the first scene of the subinterval. The LPS extracts the spacecraft time from the timecode minor frames of the first ETM+ major frame of the subinterval reported in this file. A computed start time is provided if the timecode in the first ETM+ major frame is in error. The year information is appended by LPS to the spacecraft timecode.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (4 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SUBINTERVAL_STOP_TIME	18	= yyyy-dddThh:mm:ssZ where: yyyy = 4-digit year "-" = date field separator ddd = Day of year (001 - 366) "T" = constant hh = Hours (00 - 23) ":" = time field separator mm = Minutes (00 - 59) ":" = time field separator ss = Seconds (00 - 59) "Z" = constant	The time associated with the end of the last scene of the subinterval. The LPS extracts the spacecraft time from the timecode minor frames of the last ETM+ major frame of the subinterval reported in this file. A computed end time is provided if the timecode in the last ETM+ major frame is in error. The year information is appended by LPS to the spacecraft timecode.
SUBINTERVAL_UL_CORNER_LAT	6-8	= -90.0000 through 90.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates North latitude. A negative value (-) indicates South latitude.	Calculated "actual" latitude of the subinterval's upper left corner. See A.1 for corner definitions. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_UL_CORNER_LON	6-9	= -180.0000 through 180.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates East longitude. A negative value (-) indicates West longitude.	Calculated "actual" longitude of the subinterval's upper left corner. See A.1 for corner definitions. A subinterval may start at the first actual scan (not filled) in a partial scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks

Table D-1 IGS Metadata Format Specification. (5 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SUBINTERVAL_UR_CORNER_LAT	6-8	(Same as SUBINTERVAL_UL_CORNER_LAT)	Calculated "actual" latitude of the subinterval's upper right corner. See A.1 for corner definitions. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_UR_CORNER_LON	6-9	(Same as SUBINTERVAL_UL_CORNER_LON)	Calculated "actual" longitude of the subinterval's upper right corner. See A.1 for corner definitions. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_LL_CORNER_LAT	6-8	(Same as SUBINTERVAL_UL_CORNER_LAT)	Calculated "actual" latitude of the subinterval's lower left corner. See A.1 for corner definitions. A subinterval may end at the last actual scan (not filled) in a partial scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (6 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SUBINTERVAL_LL_CORNER_LON	6-9	(Same as SUBINTERVAL_UL_CORNER_LON)	Calculated "actual" longitude of the subinterval's lower left corner. See A.1 for corner definitions. A subinterval may end at the last actual scan (not filled) in a partial scene.
SUBINTERVAL_LR_CORNER_LAT	6-8	(Same as SUBINTERVAL_ UL_CORNER_LAT)	Calculated "actual" latitude of the subinterval's lower right corner. See A.1 for corner definitions. A subinterval may end at the last actual scan (not filled) in a partial scene.
SUBINTERVAL_LR_CORNER_LON	6-9	(Same as SUBINTERVAL_ UL_CORNER_LON)	Calculated "actual" longitude of the subinterval's lower right corner. See A.1 for corner definitions. A subinterval may end at the last actual scan (not filled) in a partial scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (7 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BAND1_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 1 is present "N" indicates that Band 1 is not present	This is the "Band 1 ON" status information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 0, where a bit set condition (=1) indicates "Band 1 ON state". In the LPS, the first error-free PCD major frame (2) is used to derive this value.
BAND2_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 2 is present "N" indicates that Band 2 is not present	This is the "Band 2 ON" status information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 1, where a bit set condition (=1) indicates "Band 2 ON state".
BAND3_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 3 is present "N" indicates that Band 3 is not present	This is the "Band 3 ON" status information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 2, where a bit set condition (=1) indicates "Band 3 ON state".

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (8 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BAND4_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 4 is present "N" indicates that Band 4 is not present	This is the "Band 4 ON" status information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 3, where a bit set condition (=1) indicates "Band 4 ON state".
BAND5_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 5 is present "N" indicates that Band 5 is not present	This is the "Band 5 ON" status information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 4, where a bit set condition (=1) indicates "Band 5 ON state".
BAND6_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 6 is present "N" indicates that Band 6 is not present	This is the "Band 6 ON" status information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 5, where a bit set condition (=1) indicates "Band 6 ON state".

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (9 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
Start of Scene Level Metadata for scenes within Format 1			**The following parameter values are repeated for each ETM+ scene included in the subinterval.**
GROUP	17	= METADATA_SCENE_nn where nn = 01-99 (Up to 35 full scenes are expected in a 14-minute subinterval)	Indicates the beginning of the ETM+ Format 1 metadata Scene nn group records. This group is carried for LPS compatibility.
GROUP	12	= WRS_SCENE_nn where nn = 01-99	Indicates the beginning of the ETM+ Format 1 WRS Scene nn group records.
WRS_SCENE_NO	1-2	= 1 to 99	This is the incremental scene counter for scenes within this subinterval.
WRS_PATH	3	= 001 - 233 (Leading zeros are required.)	The WRS Path number associated with the scene.
WRS_ROW	3	= 001 - 248 (Leading zeros are required.)	The WRS Row number associated with the scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (10 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
FULL_OR_PARTIAL_SCENE	1	= "F" or "P" where: "F" = Full WRS scene "P" = Partial WRS scene at the start or end of a subinterval	This field designates whether the scene is full or partial. Partial scenes may be received at the start and/or end of a subinterval.
SCENE_CENTER_SCAN_TIME	26	= yyyy-dddThh:mm:ss.tttttttZ where: yyyy = 4-digit year "-" = date field separator ddd = Day of year (001 - 366) "T" = constant hh = Hours (00 - 23) ":" = time field separator mm = Minutes (00 - 59) ":" = time field separator ss = Seconds (00 - 59) "." = decimal point ttttttt = Fractional seconds (0000000 - 9999375) "Z" = constant	The spacecraft time associated with a WRS scene center scan number. Clock's cycle is 1/16 millisecond = .0000625; ttttttt takes on a fractional second value from 0 - .9999375 which equates to 0 - 15,999 1/16th milliseconds (15999 * .0000625 = .9999375).

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (11 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_BAND1_PRESENT	1	= "x" where: "Y" = Yes, band 1 is present "N" = No, band 1 is missing "U" = Unknown if band 1 is present	This field indicates whether band 1 is present or missing for this scene. In the LPS, this is the "Band 1 ON" state information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 0, where a bit set condition (=1) indicates "Band 1 ON state". The first error-free PCD major frame (2) associated with the scene is used to derive this value. If no valid PCD major frame falls within the scene's time boundary, then the value for the previous scene will be used. If the previous scene has no valid major frame (e.g., the first partial scene in a subinterval), then the value "U" for unknown will be used.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (12 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_BAND2_PRESENT	1	= "x" where: "Y" = Yes, band 2 is present "N" = No, band 2 is missing "U" = Unknown if band 2 is present	This field indicates whether band 2 is present or missing for this scene. Same as above with this exception: This is the "Band 2 ON" state information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 1, where a bit set condition (=1) indicates "Band 2 ON state".
SCENE_BAND3_PRESENT	1	= "x" where: "Y" = Yes, band 3 is present "N" = No, band 3 is missing "U" = Unknown if band 3 is present	This field indicates whether band 3 is present or missing for this scene. Same as above with this exception: This is the "Band 3 ON" state information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 2, where a bit set condition (=1) indicates "Band 3 ON state".
SCENE_BAND4_PRESENT	1	= "x" where: "Y" = Yes, band 4 is present "N" = No, band 4 is missing "U" = Unknown if band 4 is present	This field indicates whether band 4 is present or missing for this scene. Same as above with this exception: This is the "Band 4 ON" state information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 3, where a bit set condition (=1) indicates "Band 4 ON state".

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks

Table D-1 IGS Metadata Format Specification. (13 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_BAND5_PRESENT	1	= "x" where: "Y" = Yes, band 5 is present "N" = No, band 5 is missing "U" = Unknown if band 5 is present	This field indicates whether band 5 is present or missing for this scene. Same as above with this exception: This is the "Band 5 ON" state information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 4, where a bit set condition (=1) indicates "Band 5 ON state".
SCENE_BAND6_PRESENT	1	= "x" where: "Y" = Yes, band 6 is present "N" = No, band 6 is missing "U" = Unknown if band 6 is present	This field indicates whether band 6 is present or missing for this scene. Same as above with this exception: This is the "Band 6 ON" state information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 5, where a bit set condition (=1) indicates "Band 6 ON state".

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (14 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_CENTER_LAT	6-8	= -90.0000 through 90.0000 units are degrees (with a 4-digit precision) A positive (no sign) value indicates North latitude. A negative (-) value indicates South latitude.	WRS scene center latitude. This field is the calculated "actual" coordinate value. The computed "actual" scene centers for full and greater than half-scene length partial scenes are expected to be in the proximity of the nominal WRS scene centers. They are always indexed to actual data in the LPS band file. The computed "actual" scene centers for smaller than half-scene length partial scenes are also expected to be in the proximity of the nominal WRS scene centers, but outside the actual subinterval band data range. They are indexed to a non-existent scan 0 in the LPS band file.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (15 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_CENTER_LON	6-9	= -180.0000 through 180.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates East longitude. A negative value (-) indicates West longitude.	WRS scene center longitude. This field is the calculated "actual" coordinate value. The computed "actual" scene centers for full and greater than half a scene length partial scenes are expected to be in the proximity of the nominal WRS scene centers. They are always indexed to actual data in the LPS band file. The computed "actual" scene centers for smaller than half a scene length partial scenes are also expected to be in the proximity of the nominal WRS scene centers, but outside the actual subinterval band data range. They are indexed to a non-existent scan 0 in the LPS band file.
SCENE_UL_CORNER_LAT	6-8	= -90.0000 through 90.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates North latitude. A negative value (-) indicates South latitude.	This field defines the calculated "actual" latitude for the upper left corner of the scene. See A.1 for corner definitions.
SCENE_UL_CORNER_LON	6-9	= -180.0000 through 180.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates East longitude. A negative value (-) indicates West longitude.	This field defines the calculated "actual" longitude for the upper left corner of the scene. See A.1 for corner definitions.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks

Table D-1 IGS Metadata Format Specification. (16 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_UR_CORNER_LAT	6-8	(Same as SCENE_UL_CORNER_LAT)	This field defines the calculated "actual" latitude for the upper right corner of the scene. See A.1 for corner definitions.
SCENE_UR_CORNER_LON	6-9	(Same as SCENE_UL_CORNER_LON)	This field defines the calculated "actual" longitude for the upper right corner of the scene. See A.1 for corner definitions.
SCENE_LL_CORNER_LAT	6-8	(Same as SCENE_UL_CORNER_LAT)	This field defines the calculated "actual" latitude for the lower left corner of the scene. See A.1 for corner definitions.
SCENE_LL_CORNER_LON	6-9	(Same as SCENE_UL_CORNER_LON)	This field defines the calculated "actual" longitude for the lower left corner of the scene. See A.1 for corner definitions.
SCENE_LR_CORNER_LAT	6-8	(Same as SCENE_UL_CORNER_LAT)	This field defines the calculated "actual" latitude for the lower right corner of the scene. See A.1 for corner definitions.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (17 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_LR_CORNER_LON	6-9	(Same as SCENE_UL_CORNER_LON)	This field defines the calculated "actual" longitude for the lower right corner of the scene. See A.1 for corner definitions.
HORIZONTAL_DISPLAY_SHIFT	1-6	= -99999 through 99999 units are meters A negative value (-) defines a shift of the calculated "true" WRS scene center to the West of the nominal WRS scene center. A positive value (no sign) defines a shift of the calculated "true" WRS scene center to the East of the nominal WRS scene center.	OPTIONAL field. This field defines the horizontal distance between the perpendiculars through the calculated "true" WRS scene center and the nominal (known) WRS scene center on the ground. The LPS will maintain a lookup table of nominal WRS scene centers for computing HORIZONTAL_DISPLAY_SHIFT values.
SCENE_CCA	1-3	= 0 to 100 percentage (This field is required only in Format 1 metadata.)	Percent cloud cover assessment (CCA) for the entire scene. This CCA is an average of the CCAs for all quadrants of the WRS scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (18 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
UL_QUAD_CCA	1-3	= 0 to 100 (If provided, this field is required only in Format 1 metadata.)	OPTIONAL field. Percent cloud cover in the upper left quadrant of the scene. If quadrant scores are reported, all four must be present.
UR_QUAD_CCA	1-3	= 0 to 100 (If provided, this field is required only in Format 1 metadata.)	OPTIONAL field. Percent cloud cover in the upper right quadrant of the scene. If quadrant scores are reported, all four must be present.
LL_QUAD_CCA	1-3	= 0 to 100 (If provided, this field is required only in Format 1 metadata.)	OPTIONAL field. Percent cloud cover in the lower left quadrant of the scene. If quadrant scores are reported, all four must be present.
LR_QUAD_CCA	1-3	= 0 to 100 (If provided, this field is required only in Format 1 metadata.)	OPTIONAL field. Percent cloud cover in the lower right quadrant of the scene. If quadrant scores are reported, all four must be present.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (19 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SUN_AZIMUTH_ANGLE	3-6	= -180.0 to 180.0 units are degrees (with 1-digit precision) A positive value (no sign) indicates angles to the East or clockwise from North. A negative value (-) indicates angles to the West or counterclockwise from North.	The Sun azimuth angle at the "true" WRS scene center. (calculated by LPS from PCD processing)
SUN_ELEVATION_ANGLE	3-5	= -90.0 through 90.0 units are degrees (with 1-digit precision) A positive value (no sign) indicates a daytime scene. A negative value (-) indicates a nighttime scene.	The Sun elevation angle at the "true" WRS scene center. (calculated by LPS from PCD processing)
BAND1_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	This field describes the band gain condition at the start of a WRS scene. This information is obtained from Words 7 and 8 of the PCD/Status Data field of the first error-free VCDU in a WRS scene. If there is a band gain change within the scene it will be indicated in the next two fields.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (20 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BAND2_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	(See parameter description for BAND1_GAIN.)
BAND3_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	(See parameter description for BAND1_GAIN.)
BAND4_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	(See parameter description for BAND1_GAIN.)
BAND5_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	(See parameter description for BAND1_GAIN.)
BAND6_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	(See parameter description for BAND1_GAIN.)
BAND1_GAIN_CHANGE	1	= "x" where: "0" = no band gain change within the scene "+" = gain change from low to high within the scene "-" = gain change from high to low within the scene	This field indicates if there has been a band gain change within a scene and which direction the band gain condition changed; e.g. from high to low or low to high. The LPS generates this by evaluating corresponding band gain states in adjacent ETM+ scans (major frames).

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (21 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BAND2_GAIN_CHANGE	1	(Same as BAND1_GAIN_CHANGE)	(See parameter description for BAND1_GAIN_ CHANGE parameter)
BAND3_GAIN_CHANGE	1	(Same as BAND1_GAIN_CHANGE)	(See parameter description for BAND1_GAIN_ CHANGE parameter)
BAND4_GAIN_CHANGE	1	(Same as BAND1_GAIN_CHANGE)	(See parameter description for BAND1_GAIN_ CHANGE parameter)
BAND5_GAIN_CHANGE	1	(Same as BAND1_GAIN_CHANGE)	(See parameter description for BAND1_GAIN_ CHANGE parameter)
BAND6_GAIN_CHANGE	1	(Same as BAND1_GAIN_CHANGE)	(See parameter description for BAND1_GAIN_ CHANGE parameter)
BAND1_SL_GAIN_CHANGE	1-5	= nnnnn where: 0 = no gain change 1- 12000 = first scan line number at new band gain setting	This field indicates the scan line (SL) number within this band in the WRS scene for the first change detected in the band gain condition.
BAND2_SL_GAIN_CHANGE	1-5	(Same as BAND1_SL_GAIN_CHANGE)	(See parameter description for BAND1_SL_GAIN_ CHANGE parameter.)

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (22 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BAND3_SL_GAIN_CHANGE	1-5	(Same as BAND1_SL_GAIN_CHANGE)	(See parameter description for BAND1_SL_GAIN_ CHANGE parameter.)
BAND4_SL_GAIN_CHANGE	1-5	(Same as BAND1_SL_GAIN_CHANGE)	(See parameter description for BAND1_SL_GAIN_ CHANGE parameter.)
BAND5_SL_GAIN_CHANGE	1-5	(Same as BAND1_SL_GAIN_CHANGE)	(See parameter description for BAND1_SL_GAIN_ CHANGE parameter.)
BAND6_SL_GAIN_CHANGE	1-5	(Same as BAND1_SL_GAIN_CHANGE)	(See parameter description for BAND1_SL_GAIN_ CHANGE parameter.)
BROWSE_FILE_NAME	23	="L7xxxppprrryyyymmdd.Rnn" where: "L7" = constant (Landsat 7) xxx = station id in upper-case letters (ref. Table H-1) ppp = WRS Path rrr = WRS Row yyyy = 4-digit Year of acquisition mm = Month (01-12) dd = Day (01-31) ".R" = constant (browse file) nn = sequence number of this scene in the subinterval - same as WRS_SCENE_NO) (If provided, this field is required only in Format 1 metadata.)	OPTIONAL field if browse file will not be sent to the LP DAAC. REQUIRED field if the browse file is to be sent to the LP DAAC.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (23 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BROWSE_AVAILABLE_AT_ STATION	1	= "x" where: "Y" = Yes "N" = No (This field is required only in Format 1 metadata.)	This field indicates if scene browse imagery is available for viewing at or distribution from the IGS.
DAY_NIGHT_FLAG	1	= "x" where: "D" = Daytime scene "N" = Nighttime scene	This field indicates the day or night condition for the scene. LPS determines the day/night condition of a scene by comparing the Sun elevation values against an angle value of 0 degrees. A scene is declared a day scene if the Sun elevation angle is greater than 0 degrees; otherwise it is declared a night scene.
SCENE_QUALITY	2	= nn where: nn = 00 - 99 or nn = -1 A value of -1 means no quality assessment was made. A value of 00 means very poor quality and a value of 99 means very good quality. Leading zeros are required for positive values.	This field may integrate several measures of image quality to arrive at an integrated quality rating on a scene basis. The algorithm for the calculation of scene quality is described in D.3.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (24 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
END_GROUP	12	= WRS_SCENE_nn where nn = 01-99	Indicates the end of the ETM+ WRS scene group records.
END_GROUP	17	= METADATA_SCENE_nn where nn = 01-99	Indicates the end of the metadata scene nn level group records.
End of Scene Level Metadata for Format 1			
END_GROUP	26	= SUBINTERVAL_METADATA_FMT_1	Indicates the end of the Format 1 subinterval level metadata group records
End of Format 1 Metadata and Start of Format 2 Metadata			
GROUP	26	=SUBINTERVAL_METADATA_FMT_2	Indicates the start of the Format 2 subinterval level metadata group records.
SPACECRAFT_ID	8	= "Landsat7"	Name of satellite
SENSOR_ID	4	= "ETM+"	Sensor that acquired the data
STARTING_PATH	3	= 001 - 233 (Leading zeros are required)	The WRS path number for the scenes included in this subinterval.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (25 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
STARTING_ROW	3	= 001 - 248 (Leading zeros are required)	The starting WRS row number for the scene data included in this subinterval.
ENDING_ROW	3	= 001 - 248 (Leading zeros are required)	The ending WRS row number for the scene data included in this subinterval.
TOTAL_WRS_SCENES	1-2	= 1 - 99	The total number of scenes (including partial scenes) that are in this subinterval. The LPS produces this count from the total number of WRS scenes identified in a subinterval. The LPS does not use the absolute difference between STARTING_ROW and ENDING_ROW +1 to compute this count.
SUBINTERVAL_START_TIME	18	= yyyy-dddThh:mm:ssZ where: yyyy = 4-digit year "-" = date field separator ddd = Day of year (001 - 366) "T" = constant hh = Hours (00 - 23) ":" = time field separator mm = Minutes (00 - 59) ":" = time field separator ss = Seconds (00 - 59) "Z" = constant	The time associated with the start of the first scene of the subinterval. The LPS extracts the spacecraft time from the timecode minor frames of the first ETM+ major frame of the subinterval reported in this file. A computed start time is provided if the timecode in the first ETM+ major frame is in error. The year information is appended by LPS to the spacecraft timecode.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks

Table D-1 IGS Metadata Format Specification. (26 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SUBINTERVAL_STOP_TIME	18	= yyyy-dddThh:mm:ssZ where: yyyy = 4-digit year "-" = date field separator ddd = Day of year (001 - 366) "T" = constant hh = Hours (00 - 23) ":" = time field separator mm = Minutes (00 - 59) ":" = time field separator ss = Seconds (00 - 59) "Z" = constant	The time associated with the end of the last scene of the subinterval. The LPS extracts the spacecraft time from the timecode minor frames of the last ETM+ major frame of the subinterval reported in this file. A computed end time is provided if the timecode in the last ETM+ major frame is in error. The year information is appended by LPS to the spacecraft timecode.
SUBINTERVAL_UL_CORNER_LAT	6-8	= -90.0000 through 90.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates North latitude. A negative value (-) indicates South latitude.	Calculated "actual" latitude of the subinterval's upper left corner. See A.1 for corner definitions. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_UL_CORNER_LON	6-9	= -180.0000 through 180.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates East longitude. A negative value (-) indicates West longitude.	Calculated "actual" longitude of the subinterval's upper left corner. See A.1 for corner definitions. A subinterval may start at the first actual scan (not filled) in a partial scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (27 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SUBINTERVAL_UR_CORNER_LAT	6-8	(Same as SUBINTERVAL_UL_CORNER_LAT)	Calculated "actual" latitude of the subinterval's upper right corner. See A.1 for corner definitions. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_UR_CORNER_LON	6-9	(Same as SUBINTERVAL_UL_CORNER_LON)	Calculated "actual" longitude of the subinterval's upper right corner. See A.1 for corner definitions. A subinterval may start at the first actual scan (not filled) in a partial scene.
SUBINTERVAL_LL_CORNER_LAT	6-8	(Same as SUBINTERVAL_UL_CORNER_LAT)	Calculated "actual" latitude of the subinterval's lower left corner. See A.1 for corner definitions. A subinterval may end at the last actual scan (not filled) in a partial scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (28 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SUBINTERVAL_LL_CORNER_LON	6-9	(Same as SUBINTERVAL_UL_CORNER_LON)	Calculated "actual" longitude of the subinterval's lower left corner. See A.1 for corner definitions. A subinterval may end at the last actual scan (not filled) in a partial scene.
SUBINTERVAL_LR_CORNER_LAT	6-8	(Same as SUBINTERVAL_UL_CORNER_LAT)	Calculated "actual" latitude of the subinterval's lower right corner. See A.1 for corner definitions. A subinterval may end at the last actual scan (not filled) in a partial scene.
SUBINTERVAL_LR_CORNER_LON	6-9	(Same as SUBINTERVAL_UL_CORNER_LON)	Calculated "actual" longitude of the subinterval's lower right corner. See A.1 for corner definitions. A subinterval may end at the last actual scan (not filled) in a partial scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (29 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BAND6_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 6 is present "N" indicates that Band 6 is not present	This is the "Band 6 ON" status information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 5, where a bit set condition (=1) indicates "Band 6 ON state". In the LPS, the first error-free PCD major frame (2) is used to derive this value.
BAND7_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 7 is present "N" indicates that Band 7 is not present	This is the "Band 7 ON" status information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 6, where a bit set condition (=1) indicates "Band 7 ON state".
BAND8_PRESENT	1	= "Y" or "N" where: "Y" indicates that Band 8 is present "N" indicates that Band 8 is not present	This is the "Band 8 ON" status information obtained from PCD Serial Word "E" (major frame (2), minor frame 35, word 72), bit 0, where a bit set condition (=1) indicates "Band 8 ON state".

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (30 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
Start of Scene Level Metadata for scenes within Format 2			**The following parameter values are repeated for each ETM+ scene included in the subinterval.**
GROUP	17	= METADATA_SCENE_nn where nn = 01-99 (Up to 35 full scenes are expected in a 14-minute subinterval.)	Indicates the beginning of the ETM+ Format 2 metadata Scene nn group records. This group is carried for LPS compatibility.
GROUP	12	= WRS_SCENE_nn where nn = 01-99	Indicates the beginning of the ETM+ Format 2 WRS Scene nn group records.
WRS_SCENE_NO	1-2	= 1 to 99	This is the incremental scene counter for scenes within this subinterval.
WRS_PATH	3	= 001 - 233 (Leading zeros are required.)	The WRS Path number associated with the scene.
WRS_ROW	3	= 001 - 248 (Leading zeros are required.)	The WRS Row number associated with the scene.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (31 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
FULL_OR_PARTIAL_SCENE	1	= "F" or "P" where: "F" = Full WRS scene "P" = Partial WRS scene at the start or end of a subinterval	This field designates whether the scene is full or partial. Partial scenes may be received at the start and/or end of a subinterval.
SCENE_CENTER_SCAN_TIME	26	= yyyy-dddThh:mm:ss.tttttttZ where: yyyy = 4-digit year "-" = date field separator ddd = Day of year (001 - 366) "T" = constant hh = Hours (00 - 23) ":" = time field separator mm = Minutes (00 - 59) ":" = time field separator ss = Seconds (00 - 59) "." = decimal point ttttttt = Fractional seconds (0000000 - 9999375) "Z" = constant	The spacecraft time associated with a WRS scene center scan number. Clock's cycle is 1/16 millisecond = .0000625; ttttttt takes on a fractional second value from 0 - .9999375 which equates to 0 - 15,999 1/16th milliseconds (15999 * .0000625 = .9999375).

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (32 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_BAND6_PRESENT	1	= "x" where: "Y" = Yes, band 6 is present "N" = No, band 6 is missing "U" = Unknown if band 6 is present	This field indicates whether band 6 is present or missing for this scene. In the LPS, this is the "Band 6 ON" state information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 5, where a bit set condition (=1) indicates "Band 6 ON state". The first error-free PCD major frame (2) associated with the scene is used to derive this value. If no valid PCD major frame falls within the scene's time boundary, then the value for the previous scene will be used. If the previous scene has no valid major frame (i.e., the first partial scene in a subinterval), then the value "U" for unknown will be used.
SCENE_BAND7_PRESENT	1	= "x" where: "Y" = Yes, band 7 is present "N" = No, band 7 is missing "U" = Unknown if band 7 is present	This field indicates whether band 7 is present or missing for this scene. Same as above with this exception: This is the "Band 7 ON" state information obtained from PCD Serial Word "B" (major frame (2), minor frame 32, word 72), bit 6, where a bit set condition (=1) indicates "Band 7 ON state".

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks

Table D-1 IGS Metadata Format Specification. (33 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks

SCENE_BAND8_PRESENT	1	= "x" where: "Y" = Yes, band 8 is present "N" = No, band 8 is missing "U" = Unknown if band 8 is present	This field indicates whether band 8 is present or missing for this scene. Same as above with this exception: This is the "Band 8 ON" state information obtained from PCD Serial Word "E" (major frame (2), minor frame 35, word 72), bit 0, where a bit set condition (=1) indicates "Band 8 ON state".
SCENE_CENTER_LAT	6-8	= -90.0000 through 90.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates North latitude. A negative value (-) indicates South latitude.	WRS scene center latitude This field is the calculated "actual" coordinate value. The computed "actual" scene centers for full and greater than half a scene length partial scenes are expected to be in the proximity of the nominal WRS scene centers. They are always indexed to actual data in the LPS band file. The computed "actual" scene centers for smaller than half a scene length partial scenes are also expected to be in the proximity of the nominal WRS scene centers, but outside the actual subinterval band data range. They are indexed to a non-existent scan 0 in the LPS band file.

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (34 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_CENTER_LON	6-9	= -180.0000 through 180.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates East longitude. A negative value (-) indicates West longitude.	WRS scene center longitude. This field is the calculated "actual" coordinate value. The computed "actual" scene centers for full and greater than half a scene length partial scenes are expected to be in the proximity of the nominal WRS scene centers. They are always indexed to actual data in the LPS band file. The computed "actual" scene centers for smaller than half a scene length partial scenes are also expected to be in the proximity of the nominal WRS scene centers, but outside the actual subinterval band data range. They are indexed to a non-existent scan 0 in the LPS band file.
SCENE_UL_CORNER_LAT	6-8	= -90.0000 through 90.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates North latitude. A negative value (-) indicates South latitude.	This field defines the calculated "actual" latitude for the upper left corner of the scene. See A.1 for corner definitions.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (35 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_UL_CORNER_LON	6-9	= -180.0000 through 180.0000 units are degrees (with a 4-digit precision) A positive value (no sign) indicates East longitude. A negative value (-) indicates West longitude.	This field defines the calculated "actual" longitude for the upper left corner of the scene. See A.1 for corner definitions.
SCENE_UR_CORNER_LAT	6-8	(Same as SCENE_UL_CORNER_LAT)	This field defines the calculated "actual" latitude for the upper right corner of the scene. See A.1 for corner definitions.
SCENE_UR_CORNER_LON	6-9	(Same as SCENE_UL_CORNER_LON)	This field defines the calculated "actual" longitude for the upper right corner of the scene. See A.1 for corner definitions.
SCENE_LL_CORNER_LAT	6-8	(Same as SCENE_UL_CORNER_LAT)	This field defines the calculated "actual" latitude for the lower left corner of the scene. See A.1 for corner definitions.
SCENE_LL_CORNER_LON	6-9	(Same as SCENE_UL_CORNER_LON)	This field defines the calculated "actual" longitude for the lower left corner of the scene. See A.1 for corner definitions.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (36 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SCENE_LR_CORNER_LAT	6-8	(Same as SCENE_UL_CORNER_LAT)	This field defines the calculated "actual" latitude for the lower right corner of the scene. See A.1 for corner definitions.
SCENE_LR_CORNER_LON	6-9	(Same as SCENE_UL_CORNER_LON)	This field defines the calculated "actual" longitude for the lower right corner of the scene. See A.1 for corner definitions.
HORIZONTAL_DISPLAY_SHIFT	1-6	= -99999 through 99999 units are meters A negative value (-) defines a shift of the calculated "true" WRS scene center to the West of the nominal WRS scene center. A positive value (no sign) defines a shift of the calculated "true" WRS scene center to the East of the nominal WRS scene center.	OPTIONAL field. This field defines the horizontal distance between the perpendiculars through the calculated "true" WRS scene center and the nominal (known) WRS scene center on the ground. The LPS will maintain a lookup table of nominal WRS scene centers for computing HORIZONTAL_DISPLAY_SHIFT values for WRS scenes.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (37 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
SUN_AZIMUTH_ANGLE	3-6	= -180.0 to 180.0 units are degrees (with 1-digit precision) A positive value (no sign) indicates angles to the East or clockwise from North. A negative value (-) indicates angles to the West or counterclockwise from North.	The Sun azimuth angle at the "true" WRS scene center (calculated by LPS from PCD processing)
SUN_ELEVATION_ANGLE	3-5	= -90.0 through 90.0 units are degrees (with 1-digit precision) A positive value (no sign) indicates a daytime scene. A negative value (-) indicates a nighttime scene.	The Sun elevation angle at the "true" WRS scene center (calculated by LPS from PCD processing)
BAND6_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	This field describes the band gain condition at the start of a WRS scene. This information is obtained from Words 7 and 8 of the PCD/Status Data field of the first error-free VCDU in a WRS scene. If there is a band gain change within the scene it will be indicated in the next two fields.
BAND7_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	(See parameter description for BAND6_GAIN.)

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (38 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BAND8_GAIN	1	= "x" where: "L" = Low gain condition "H" = High gain condition	(See parameter description for BAND6_GAIN.)
BAND6_GAIN_CHANGE	1	= "x" where: "0" = no band gain change within the scene "+" = gain change from low to high within the scene "-" = gain change from high to low within the scene	This field indicates if there has been a band gain change within a scene and which direction the band gain condition changed; e.g. from high to low or low to high. The LPS generates this by evaluating corresponding band gain states in adjacent ETM+ scans (major frames).
BAND7_GAIN_CHANGE	1	(Same as BAND6_GAIN_CHANGE)	(See parameter description for BAND6_GAIN_ CHANGE parameter)
BAND8_GAIN_CHANGE	1	(Same as BAND6_GAIN_CHANGE)	(See parameter description for BAND6_GAIN_ CHANGE parameter)
BAND6_SL_GAIN_CHANGE	1-5	= nnnnn where: 0 = no gain change 1- 12000 = first scan line number at new band gain setting	This field indicates the scan line (SL) number within this band in the WRS scene for the first change detected in the band gain condition.
BAND7_SL_GAIN_CHANGE	1-5	(Same as BAND6_SL_GAIN_CHANGE)	(See parameter description for BAND6_SL_GAIN_ CHANGE parameter.)

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (39 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
BAND8_SL_GAIN_CHANGE	1-5	(Same as BAND6_SL_GAIN_CHANGE)	(See parameter description for BAND6_SL_GAIN_ CHANGE parameter.)
DAY_NIGHT_FLAG	1	= "x" where: "D" = Daytime scene "N" = Nighttime scene	This field indicates the day or night condition for the scene. LPS determines the day/night condition of a scene by comparing the Sun elevation values against an angle value of 0 degrees. A scene is declared a day scene if the Sun elevation angle is greater than 0 degrees; otherwise it is declared a night scene.
SCENE_QUALITY	2-3	= nn where: nn = 00 - 99 or nn = -1 A value of -1 means no quality assessment was made. A value of 00 means very poor quality and a value of 99 means very good quality. Leading zeros are required for positive values.	This field may integrate several measures of image quality to arrive at an integrated quality rating on a scene basis. The algorithm for the calculation of scene quality is described in D.3.
END_GROUP	12	= WRS_SCENE_nn where nn = 01-99	Indicates the end of the ETM+ WRS scene nn group records.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (40 of 41)

Parameter Name	Size (ASCII Bytes)	Value, Format, Range, and Units	Parameter Description / Remarks
END_GROUP	17	= METADATA_SCENE_nn where nn = 01-99	Indicates the end of the metadata scene nn level metadata group records.
End of Scene Level Metadata for Format 2			
END_GROUP	26	=SUBINTERVAL_METADATA_FMT_2	Indicates the end of the Format 2 subinterval level metadata group records.
END_GROUP	13	= METADATA_FILE	Indicates the end of the Metadata file records for an ETM+ subinterval.
END	0		Indicates the end of the file.

(Note: In this table, quotation marks are used in the Value definitions to signify literal characters or strings that are constants in the Value field.)

Table D-1 IGS Metadata Format Specification. (41 of 41)

```
                    /*   IGS-PROVIDED LANDSAT-7 METADATA FORMAT   */

                              /* ------------------------------ */
                              /*   Metadata File Header   */
                              /* ------------------------------ */
GROUP = METADATA_FILE
    GROUP = METADATA_FILE_INFO
        FILE_NAME = "L7PAC032036199806040.MTA"
        FILE_CREATION_DATE_TIME = 1998-06-04T11:36:48Z
        FILE_VERSION_NO =  0
        STATION_ID = "PAC"
    END_GROUP = METADATA_FILE_INFO

                              /* -------------------------------------------- */
                              /*   Sub-Interval Metadata - Format 1    */
                              /* -------------------------------------------- */
    GROUP = SUBINTERVAL_METADATA_FMT_1
        SPACECRAFT_ID = "Landsat7"
        SENSOR_ID = "ETM+"
        STARTING_PATH = 032
        STARTING_ROW = 036
        ENDING_ROW = 061
        TOTAL_WRS_SCENES = 26


        /*  Start and stop time of the subinterval  */

        SUBINTERVAL_START_TIME    = 1998-155T04:01:49Z
        SUBINTERVAL_STOP_TIME     = 1998-155T04:13:11Z


        /*   Calculated latitude, longitude of subinterval's four corners        */
        SUBINTERVAL_UL_CORNER_LAT      = 35.5833     /* 35 deg 35 min North latitude */
        SUBINTERVAL_UL_CORNER_LON      = –105.1333     /* 105 deg 8 min West long.   */
        SUBINTERVAL_UR_CORNER_LAT      =  35.1333
        SUBINTERVAL_UR_CORNER_LON      =  –103.1667
        SUBINTERVAL_LL_CORNER_LAT      =  –1.9000     /*  1 deg 54 min South latitude  */
        SUBINTERVAL_LL_CORNER_LON      =  –109.8833
        SUBINTERVAL_LR_CORNER_LAT      =  –2.3833
        SUBINTERVAL_LR_CORNER_LON      = –108.3333
```

Figure D-2   Example of IGS Metadata Format. (1 of 7)

```
    /*   BAND#_PRESENT is derived from PCD   */
    BAND1_PRESENT = "Y"
    BAND2_PRESENT = "Y"
    BAND3_PRESENT = "Y"
    BAND4_PRESENT = "Y"
    BAND5_PRESENT = "Y"
    BAND6_PRESENT = "Y"

                        /* ------------------------------------------------ */
                        /*   Scene Metadata Groups - Format 1   */
                        /* ------------------------------------------------ */

GROUP = METADATA_SCENE_01
        GROUP = WRS_SCENE_01

            WRS_SCENE_NO                = 1
            WRS_PATH                    = 032
            WRS_ROW                     = 036
            FULL_OR_PARTIAL_SCENE       = "F"
            SCENE_CENTER_SCAN_TIME      = 1998-155T04:02:01.1234567Z


            SCENE_BAND1_PRESENT         =  "Y"
            SCENE_BAND2_PRESENT         =  "Y"
            SCENE_BAND3_PRESENT         =  "Y"
            SCENE_BAND4_PRESENT         =  "Y"
            SCENE_BAND5_PRESENT         =  "Y"
            SCENE_BAND6_PRESENT         =  "Y"

            /*   Calculated latitude, longitude of this scene's center and four corners,        */
            /*   using PCD position and attitude information                                    */

            SCENE_CENTER_LAT            = 34.6333    /*  34 deg 38 min North latitude   */
            SCENE_CENTER_LON            = –104.4500  /* 104 deg 27 min West long. */
            SCENE_UL_CORNER_LAT         = 35.5833
            SCENE_UL_CORNER_LON         = –105.1333
            SCENE_UR_CORNER_LAT         = 35.1333
            SCENE_UR_CORNER_LON         = –103.1667
            SCENE_LL_CORNER_LAT         = 34.0000
            SCENE_LL_CORNER_LON         = –105.6000
            SCENE_LR_CORNER_LAT         = 33.6500
            SCENE_LR_CORNER_LON         = –103.7500
            HORIZONTAL_DISPLAY_SHIFT = –34
```

Figure D-2   Example of IGS Metadata Format. (2 of 7)

```
/*   Cloud Cover Assessment Score          */

SCENE_CCA              = 40        /*   40% cloud cover   */
UL_QUAD_CCA            = 35
UR_QUAD_CCA            = 20
LL_QUAD_CCA            = 70
LR_QUAD_CCA                 = 35

SUN_AZIMUTH_ANGLE    = 35.0
SUN_ELEVATION_ANGLE = 56.3

/*   Indication of Band gain setting at start of this scene   */
BAND1_GAIN      = "H"
BAND2_GAIN      = "H"
BAND3_GAIN      = "H"
BAND4_GAIN      = "H"
BAND5_GAIN      = "H"
BAND6_GAIN      = "L"              /*  L is default gain for Band 6 Format 1   */

/*   Indication of a Band gain setting change within this scene            */
BAND1_GAIN_CHANGE        = "0"
BAND2_GAIN_CHANGE        = "0"
BAND3_GAIN_CHANGE        = "0"
BAND4_GAIN_CHANGE        = "0"
BAND5_GAIN_CHANGE        = "0"
BAND6_GAIN_CHANGE        = "0"

/*   Scan line at which a Band gain change occurred in this scene              */
BAND1_SL_GAIN_CHANGE   = 0
BAND2_SL_GAIN_CHANGE   = 0
BAND3_SL_GAIN_CHANGE   = 0
BAND4_SL_GAIN_CHANGE   = 0
BAND5_SL_GAIN_CHANGE   = 0
BAND6_SL_GAIN_CHANGE   = 0
BROWSE_FILE_NAME = "L7EDC03203619980604.R01"
BROWSE_AVAILABLE_AT_STATION    = "Y"

DAY_NIGHT_FLAG          = "D"
```

Figure D-2   Example of IGS Metadata Format. (3 of 7)

```
            SCENE_QUALITY            = 97


      END_GROUP = WRS_SCENE_01
   END_GROUP = METADATA_SCENE_01               /*   End of scene 1 metadata   */


   GROUP = METADATA_SCENE_02
      GROUP = WRS_SCENE_02

                         /*   Metadata for scene 2 of Format 1's subinterval   */

      END_GROUP = WRS_SCENE_02
   END_GROUP = METADATA_SCENE_02


   GROUP = METADATA_SCENE_nn
      GROUP = WRS_SCENE_nn

                         /*    nn = sequence number of last scene   */

      END_GROUP = WRS_SCENE_NN
   END_GROUP = METADATA_SCENE_NN

END_GROUP = SUBINTERVAL_METADATA_FMT_1

                          /* ---------------------------------------------- */
                          /*   Sub-Interval Metadata - Format 2    */
                          /* ---------------------------------------------- */

GROUP = SUBINTERVAL_METADATA_FMT_2
   SPACECRAFT_ID = "Landsat7"
   SENSOR_ID= "ETM+"
   STARTING_PATH = 032
   STARTING_ROW = 036
   ENDING_ROW = 061
   TOTAL_WRS_SCENES = 26
```

Figure D-2 Example of IGS Metadata Format. (4 of 7)

```
    /*  Start and stop time of the subinterval  */
    SUBINTERVAL_START_TIME    = 1998-155T04:01:49Z
    SUBINTERVAL_STOP_TIME     = 1998-155T04:13:11Z


    /*   Calculated latitude, longitude of subinterval's four corners                  */
    SUBINTERVAL_UL_CORNER_LAT      = 35.5833    /*  35 deg 35 min North latitude  */
    SUBINTERVAL_UL_CORNER_LON      = –105.1333   /*  105 deg 8 min West long.   */
    SUBINTERVAL_UR_CORNER_LAT      = 35.1333
    SUBINTERVAL_UR_CORNER_LON      = –103.1667
    SUBINTERVAL_LL_CORNER_LAT      = –1.9000   /*  1 deg 54 min South latitude    */
    SUBINTERVAL_LL_CORNER_LON      = –109.8833
    SUBINTERVAL_LR_CORNER_LAT      = –2.3833
    SUBINTERVAL_LR_CORNER_LON      = –108.3333

    /*   BAND#_PRESENT is derived from PCD   */
    BAND6_PRESENT = "Y"
    BAND7_PRESENT = "Y"
    BAND8_PRESENT = "Y"

                /* ---------------------------------------------------- */
                /*   Scene Metadata Groups - Format 2   */
                /* ----------------------------------------------------- */

GROUP = METADATA_SCENE_01
        GROUP = WRS_SCENE_01

            WRS_SCENE_NO                 = 1
            WRS_PATH                     = 032
            WRS_ROW                      = 036
            FULL_OR_PARTIAL_SCENE        = "F"
            SCENE_CENTER_SCAN_TIME       = 1998-155T04:02:01.1234567Z

            SCENE_BAND6_PRESENT          =  "Y"
            SCENE_BAND7_PRESENT          =  "Y"
            SCENE_BAND8_PRESENT          =  "Y"

            /*   Calculated latitude, longitude of this scene's center and four corners,        */
            /*   using PCD position and attitude information                                   */

            SCENE_CENTER_LAT             = 34.6333   /*  34 deg 38 min North latitude   */
            SCENE_CENTER_LON             = –104.4500  /* 104 deg 27 min West long.  */
```

Figure D-2   Example of IGS Metadata Format. (5 of 7)

```
        SCENE_UL_CORNER_LAT        =  35.5833
        SCENE_UL_CORNER_LON        =  –105.1333
        SCENE_UR_CORNER_LAT        =  35.1333
        SCENE_UR_CORNER_LON        =  –103.1667
        SCENE_LL_CORNER_LAT        =  34.0000
        SCENE_LL_CORNER_LON        =  –105.6000
        SCENE_LR_CORNER_LAT        =  33.6500
        SCENE_LR_CORNER_LON        =  –103.7500
        HORIZONTAL_DISPLAY_SHIFT   =  –34

        SUN_AZIMUTH_ANGLE    = 35.0
        SUN_ELEVATION_ANGLE  = 56.3

        /*   Indication of Band gain setting at start of this scene   */
        BAND6_GAIN      = "H"          /*  H is default gain for Band 6 Format 2   */
        BAND7_GAIN      = "H"
        BAND8_GAIN      = "H"

        /*   Indication of a Band gain setting change within this scene        */
        BAND6_GAIN_CHANGE        = "0"
        BAND7_GAIN_CHANGE        = "–"
        BAND8_GAIN_CHANGE        = "0"

        /*   Scan line at which a Band gain change occurred in this scene   */
        BAND6_SL_GAIN_CHANGE   = 0
        BAND7_SL_GAIN_CHANGE   = 1564
        BAND8_SL_GAIN_CHANGE   = 0

        DAY_NIGHT_FLAG                  = "D"


        SCENE_QUALITY           = –1


    END_GROUP = WRS_SCENE_01
  END_GROUP = METADATA_SCENE_01           /*   End of scene 1 metadata   */
```

Figure D-2 Example of IGS Metadata Format. (6 of 7)

```
        GROUP = METADATA_SCENE_02
            GROUP = WRS_SCENE_02

                              /*   Metadata for scene 2 of Format 2's subinterval   */

            END_GROUP = WRS_SCENE_02
        END_GROUP = METADATA_SCENE_02


        GROUP = METADATA_SCENE_NN
            GROUP = WRS_SCENE_NN

                              /*    nn = sequence number of last scene   */

            END_GROUP = WRS_SCENE_NN
        END_GROUP = METADATA_SCENE_NN

    END_GROUP = SUBINTERVAL_METADATA_FMT_2

END_GROUP = METADATA_FILE

END                                                         /*   End of this metadata file   */
```

Figure D-2 Example of IGS Metadata Format. (7 of 7)

D.3 Algorithm for Calculation of Scene Quality

A two digit number that separates image and PCD data quality is used for Landsat 7. The first digit represents image data quality and can range in value from 0 to 9. The second digit represents PCD quality and can range in value from 0 to 9. The formula for the combined score is:

image score * 10 + PCD score

The following paragraphs describe how the image quality and PCD quality scores are assigned.

D.3.1 Image Quality Component

The image quality digit is based on the number and distribution of bad scans or equivalent bad scans in a scene. It is computed by dividing the total number of filled minor frames for a scene by 6313 (the nominal number of image data minor frames in a scan for 30 meter bands). This will give a number of equivalent bad scans.

The distribution of filled minor frames is characterized as being either clustered or scattered. A cluster of 128 bad scans will still yield a scene with a cluster 246 good scans which is almost 2/3 of a scene. A scattering of 128 bad scans may make the entire image worthless.

What defines clustering versus scattering? It is determined that bad equivalent scans are clustered if they occur within a grouping of 128 contiguous scans (approximately 1/3 of a scene). Errors are characterized as scattered if they occur outside the bounds of 128 contiguous scans. The image score is assigned according to the rules in Table D-2.

SCORE	IMAGE QUALITY
9	no errors detected, a perfect scene
8	≤ 4 but > 0 equivalent bad scans, clustered
7	≤ 4 but > 0 equivalent bad scans, scattered
6	≤ 16 but > 4 equivalent bad scans, clustered
5	≤ 16 but > 4 equivalent bad scans, scattered
4	≤ 64 but > 16 equivalent bad scans, clustered
3	≤ 64 but > 16 equivalent bad scans, scattered
2	≤ 128 but > 64 equivalent bad scans, clustered
1	≤ 128 but > 64 equivalent bad scans, scattered
0	> 128 equivalent bad scans, scattered (> 33% of the scene is bad)

Table D-2 Image Quality Scoring Rules.

D.3.2 PCD Quality Component

The PCD quality digit is based on the number and distribution of filled PCD minor frames. There are approximately 7 PCD major frames for a standard WRS scene comprised of 375 scans. Each PCD major frame consists of 128 minor frames or 16,384 bytes. Clustering of filled PCD minor frames indicates that errors are localized whereas scattering indicates that numerous or all major frames may be affected.

What defines clustering versus scattering? Each PCD minor frame has 16 jitter measurements and corresponds to 30 milliseconds or approximately 1/2 of a scan. Two minor frames correspond to a single scan while 256 minor frames (i.e., 2 PCD major frames) correspond to 128 scans or approximately 1/3 of a scene.

Like the image data, it is determined that bad PCD minor frames are clustered if they occur within a grouping of 2 contiguous PCD major frames (1/3 of a scene). Errors are characterized as scattered if they occur outside the bounds of contiguous PCD major frames. The PCD score is assigned according to the rules in Table D-3.

SCORE	PCD QUALITY
9	no PCD errors detected
8	≤ 8 but > 0 bad minor frames, clustered
7	≤ 8 but > 0 bad minor frames, scattered
6	≤ 32 but > 8 bad minor frames, clustered
5	≤ 32 but > 8 bad minor frames, scattered
4	≤ 128 but > 32 bad minor frames, clustered
3	≤ 128 but > 32 bad minor frames, scattered
2	≤ 256 but > 128 bad minor frames, clustered
1	≤ 256 but > 128 bad minor frames, scattered
0	> 256 bad minor frames, scattered (>33% of the scene is bad)

Table D-3 PCD Quality Scoring Rules.

D.3.3 Scene Quality

The score calculated using the methods described above are recorded in the scene level metadata under the keyword SCENE_QUALITY. Using this scoring system the highest possible rating for an image would be 99, the lowest 00. A "-1" signals that scene quality analysis was not performed. The score treats missing image data more critically than missing or filled PCD data. For example, an image with 16 filled scans that are scattered and with errorless PCD would have a 59 score whereas an image with intact image data and 32 filled PCD minor frames that are scattered would receive a score of 95. The rationale is that PCD is less important because missing values can always be extrapolated or interpolated to enable level 1 processing. Missing image data cannot be retrieved and thus impacts the user more severely than missing PCD. The score construct unambiguously alerts the user to image data deterioration.

Appendix E Browse Data Format

Transfer of browse imagery from the IGS to the DAAC is not required, but it is encouraged if a station does not plan to provide online access to its browse products. The characteristics of the browse image are described in E.1. The browse product format is described in E.2. For information purposes only, the LPS browse generation process is described in E.3. The mechanism for transfer of browse data from the IGS to the DAAC is specified in Appendix F.

Several of the Reference documents apply to browse data:

- the Hierarchical Data Format (HDF) used to package the browse data (Reference Document 8)
- LPS browse generation algorithms (Reference Documents 9 and 10)

E.1 Browse Image Characteristics

The characteristics of the Landsat 7 browse image and the permissible values of each characteristic are specified in Table E-1. Browse data generated by the IGSs, whether sent to the DAAC or not, must be generated within the ranges specified in the table. For most of the characteristics listed, the value used in generating the browse image is left to the IGS to choose. For information purposes, the values of each characteristic for the LPS browse product are also given in Table E-1.

It is highly recommended that contrast stretch be applied to the browse product to not only remove the possible effects of low solar illumination angles and inappropriate gain settings but also to exploit the full 8-bit dynamic range for improved viewing.

BROWSE PRODUCT CHARACTERISTIC	ALLOWABLE IGS VALUE RANGE	VALUE USED BY THE LPS
Subsampling	IGS choice	None
Wavelet passes	IGS choice	3 (64:1)
Contrast stretch	IGS choice	Applied prior to compression
Browse image size	IGS choice	825 samples (width) x 750 lines (height)
Number of bands	3	3
Selected bands	IGS choice	Operator selectable - default: 5/4/2 (RGB)
Radiometric correction	IGS choice	Yes, using nominal gains and offsets
Browse framing	Scene based	Scene based
Interlace format	Pixel interlace	Pixel interlace
Browse file size	IGS choice	1.85 MB
Compression / Type	Yes / JPEG	Yes / JPEG
Compression quality factor	IGS choice	90
Compression browse file size	≤ 100 KB	100 - 185 KB
Browse file format	HDF (Note 1)	HDF

Note 1: Unix-based tools for converting JFIF to HDF and JPEG to HDF will be made available to the IGSs.

Table E-1 Browse Image Characteristics.

E.2 Browse Product Format

The three-banded, JPEG compressed, and pixel interlaced browse image submitted to the DAAC by the IGSs must be in HDF. The HDF data model employed for the browse product is the 24-bit raster image or RIS24. An HDF application programming interface (API) for the RIS24 data model is freely available on the NCSA ftp server. This interface includes a set of routines designed to simplify the process of storing and retrieving an RIS24 image. Although programming is required, all the low level details can be ignored. All HDF API routines are available in both Fortran-77 and C.

An IGS browse image stored in HDF is composed of: the two-dimensional 24-bit raster image, its dimensions, and its attributes. Band selection and image dimensioning are IGS choices as long as the physical file size of 100 KB is not exceeded. The LP DAAC client software will have a scrollable image area of approximately 620 by 620 pixels. These dimensions should serve as a guideline, not a restriction. Larger images are acceptable, but users may need to use the viewer's scrolling features to see the entire image.

JPEG compression is required and is conveniently performed using the RIS24 API. The 100 KB restriction is a post compression limit. The required interlace mode is pixel interlaced as opposed to scan line or band interlacing. The interlace format describes the physical format of an image as it is stored both in memory and in the file. After an image is reduced to the desired browse size it must be pixel interlaced in memory. The RIS24 routines will automatically store the browse image on disk in the same format.

The C program in Figure E-1 illustrates the straightforward programming steps necessary to create a browse image in HDF. The names of all C routines in the RIS24 interface are prefaced by "DF24". The code does not illustrate populating the browse_image array with actual data. The default interlace setting is pixel interlaced, therefore, it is not explicitly set.

E.3 LPS Browse Generation Process

This section describes the process used by the Landsat 7 Processing System at EDC to generate the browse data for US acquisitions. It is presented as an example only; there is no requirement for the IGSs to process their browse data in this manner.

Landsat 7 browse is generated during LPS processing using bands 5, 4, and 2 from Format 1 Level 0R data. The browse is framed according to standard WRS scene dimensions although partial scene browse can occur at the beginning or end of a subinterval.

The three Level 0R bands used for the browse first undergo radiometric correction using nominal gains and offsets from the Calibration Parameter File. Afterwards, the bands are reduced by a factor of 64 to produce a 3-banded browse image that is 825 columns by 750 lines in size. A wavelet algorithm, described in Reference Documents 9 and 10, is used for image reduction. Its primary benefit – the preservation of high frequency information – makes this approach superior to subsampling. The encoded algorithm, written in the C programming language, is available from the USGS Landsat Project Office upon request.

```
#include "hdf.h"
#include "stdio.h"
#include "hcomp.h"
#define WIDTH 825
#define HEIGHT 750
#define PIXEL_DEPTH 3
#define NUM_BROWSE_BANDS 3

main()
{
static uint8 browse_image[HEIGHT] [WIDTH] [PIXEL_DEPTH];
static int bandIDs[NUM_BROWSE_BANDS] = {5, 4, 2}, wavelet_runs = 3,  pixel_interlacing = 0;
static char browse_file_name[] = {"L7EDC03203619980604.R01"};
static char ref_metadata_file_name[] = {"L7EDC032036199806040.MTA"};
static float UpperClipPercent = 2.5, LowerClipPercent = 4.1;

/* the comp_info structure contains the quality and baseline variables. Compress_info points to this structure */

static  comp_info compress_info;

/* open the SDS interface and set the attribute values */

browse_SDid = SDstart ("browse_example.hdf", DFACC_CREATE);

SDsetattr (browse_SDid, "multiband_browse_file_label",  DFNT_CHAR8, sizeof (browse_file_name),
           (char *) browse_file_name);
SDsetattr (browse_SDid, "ref_metadata_file_name", DFNT_CHAR8, sizeof (ref_metadata_file_name),
           (char *) ref_metadata_file_name);
SDsetattr (browse_SDid, "band_IDs", DFNT_INT32, NUM_BROWSE_BANDS, (VOIDP) bandIDs);
SDsetattr (browse_SDid, "wavelet_runs", DFNT_INT32, 1, (VOIDP) &wavelet_runs);
SDsetattr (browse_SDid, "stretch_clip%_high", DFNT_FLOAT32, 1, (VOIDP) &UpperClipPercent);
SDsetattr (browse_SDid, "stretch_clip%_low", DFNT_FLOAT32, 1, (VOIDP) &LowerClipPercent);

/* close the SDS interface which writes the attribute values to the file*/

SDend (browse_SDid);

/*  Set interlace scheme to pixel interlacing and initialize the JPEG compression structure. The JPEG quality
factor is set to 90. The baseline factor is set to 1 which forces the quantization tables into the full 0-255 range */

DF24setil (pixel_interlacing);
compress_info.jpeg.quality = 90;
compress_info.jpeg.force_baseline = 1;

/* set JPEG compression for storing the image */

DF24setcompress(COM_JPEG, &compress_info);

/* write the 24 bit browse image to a file */

DF24addimage("Browse_example.hdf", (VOIDP) browse_image, WIDTH, HEIGHT);
}
```

Figure E-1   Example – Writing a Browse Image Using C.

After wavelet reduction, each band is automatically enhanced using a saturating linear stretch that maps a minimum and maximum value to 0 and 255 respectively. Minimum and maximum cutoffs are determined by histogramming the image values from each band, clipping 2.5% from the top end of the histogram, and clipping 4.1% (includes additional 1.6% from fill) from the bottom end of the histogram. All intervening input values are scaled proportionately .

The LPS browse product comprises the 24-bit image described above and text attributes containing descriptive auxiliary information or metadata.

Once the browse image is wavelet reduced and stretched, it is converted into the HDF 24-bit raster image, or RIS24, data model. The RIS24 data structure includes: the actual RGB image, its dimensions (length, width, depth), and its attributes. The image and the dimensions are defined by the following parameters that are input by the operator or hardcoded into the software:

- image_file_name
- image_interlace_il
- image_compression
- compression_quality_factor

The following attributes serve as metadata for the LPS browse image:

- browse_file_name
- ref_metadata_file_name
- band_IDs
- wavelet_runs
- stretch_clip%_high
- stretch_clip%_low

When the data is written to the HDF file, it is structured as shown in Table E-2.

HDF TAG	DD BLOCK
IMAGE_DIMENSION_WIDTH, IMAGE_DIMENSION_LENGTH, IMAGE_DIMENSION_DEPTH	
IMAGE DATA	
IMAGE DATA	
• • •	
IMAGE DATA	
ATTRIBUTES	

Table E-2 LPS Browse Image HDF File Structure.

The DD BLOCK, where DD stands for Data Descriptor, contains a JPEG flag (indicating the data is JPEG compressed), and specifies the name and byte offset for the dimension parameters, the image data itself, and the attributes.

The programming model for writing a RIS24 image consists of specifying the data layout or interlace structure, setting the compression method, and writing the image to a file. The browse image for Landsat 7 employs pixel interlacing (i.e., band interleaved by pixel) and the JPEG compression algorithm which reduces the image from 1.86 MB to approximately 150 KB in size.

The attributes are created and affixed to the RIS24 browse image using the HDF Scientific Data Set (SDS) software interface.

A C-encoded example for creating a browse image using the RIS24 and SDS interfaces is presented in Figure E-1. Generalized Fortran and C examples for creating a RIS24 image, defining and writing attributes, and further model details are provided in the HDF Users Guide (Ref. Doc. 8).

Appendix F Transfer Of Data From IGS To DAAC

Transfers of data from the IGSs to the DAAC are made using electronic transfer or physical media. Electronic transfer applies only to metadata. Physical media transfer applies to both metadata and browse data. All deliveries of browse data must be accompanied by the corresponding metadata file(s), even if the metadata was previously delivered to the DAAC by electronic transfer.

F.1 Electronic Transfer

The electronic transfer mechanism is summarized in Figure F-1. The transfer process is described below and depicted in flow chart format in Figure F-2. The next three sections describe the files that facilitate the transfer, and the last section discusses error handling and backup methods.

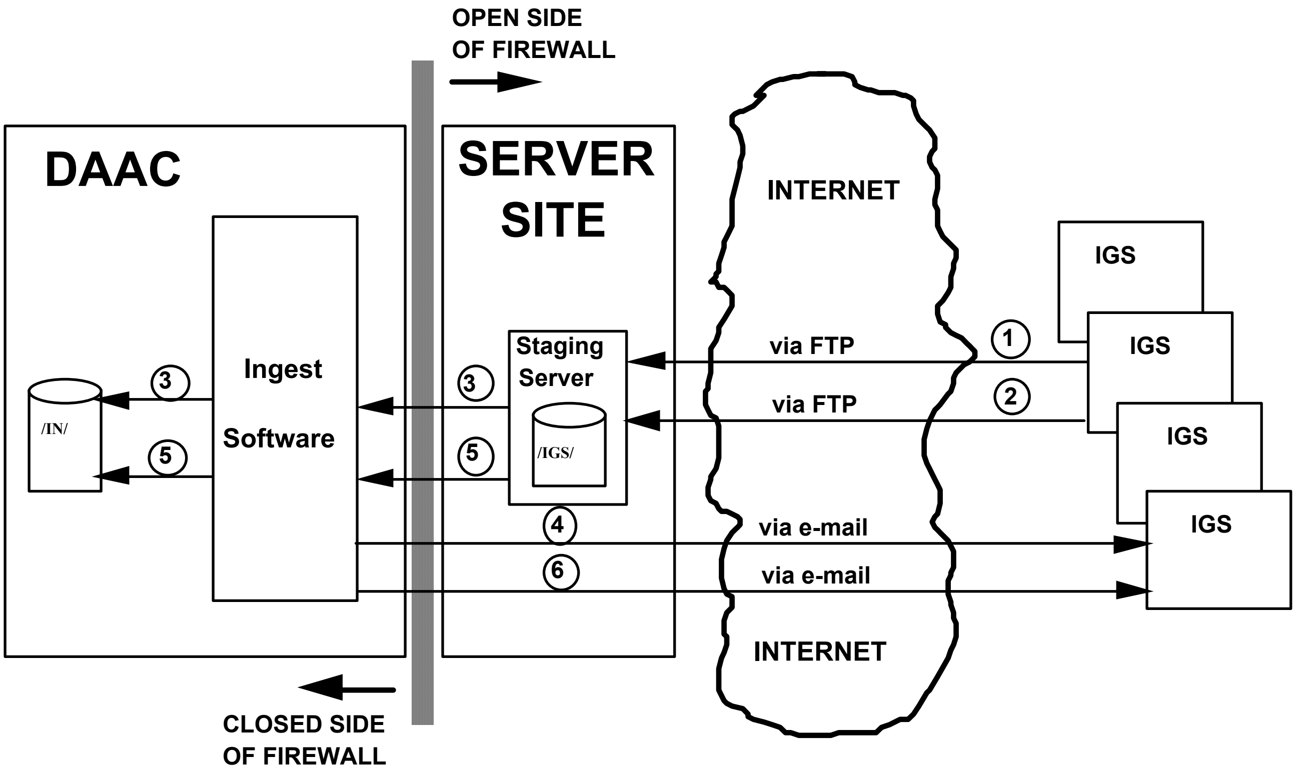
For each subinterval, the IGS generates one metadata file (containing both Format 1 and Format 2 data). The IGS sends the metadata file via FTP to a specified location on the staging server (see the directory structure in Figure F-3). The IGS then generates a Product Delivery Record (PDR) for the metadata file being submitted. The PDR file is then placed in a known directory on the staging server using FTP. There is one PDR file for each subinterval of metadata.

The LP DAAC polls the staging server PDR directory on a routine basis. When a PDR is found on the staging server, it is transferred to a closed server and validated for proper content and format. If an error is found in the PDR, processing is terminated and none of its files are transferred to a closed server for processing until a corrected PDR is received and successfully processed. When a problem in the PDR is found, either a short or long PDR Discrepancy file is generated by the DAAC and sent to the originating IGS via e-mail. In either case, the associated metadata file is deleted from the staging server. The IGS corrects the problem described in the PDR Discrepancy file and submits the corrected PDR to the PDR directory on the staging server via FTP, along with the associated metadata file. When the PDR is successfully retrieved and validated, the DAAC does not send anything to the IGS but continues on to the next step of transferring the associated metadata file onto a closed server for ingest and archiving.

The metadata file is checked for conformance with the ODL standards. If no problems are found, the metadata is ingested into the archive and a short Production Acceptance Notification (PAN) file indicating success is generated and sent via e-mail to the IGS.

If a problem is found during transfer, ingest, or archival of the metadata file, either a short or long PAN file is generated containing a description of the problem and is sent via e-mail to the IGS. Resubmission of the metadata file is done as if it were the original submission – i.e., a PDR file and the metadata file, including corrections, are sent to the staging server. All of the original files (PDR and metadata files) are deleted.

There is a one-to-one correspondence among the PDR, the PDR Discrepancy (if required to be generated), and the PAN files.



1. Metadata file(s) are sent to the staging server from the IGS via FTP and "put" in the /DATA directory.

2. The associated Product Delivery Record file is then sent to the staging server from the IGS via FTP, and "put" in the /PDR directory.

3. The Product Delivery Record is processed first.

4. If errors are found in the Product Delivery Record, they are reported in the Product Delivery Record Discrepancy file which is sent via e-mail to the IGS.

5. After no errors are found in the Product Delivery Record, metadata is ingested and processed.

6. Results of metadata processing are reported in the Production Acceptance Notification file which is sent to the IGS via e-mail.

Figure F-1 DAAC Communications Architecture and Data Flow for Electronic Transfer.

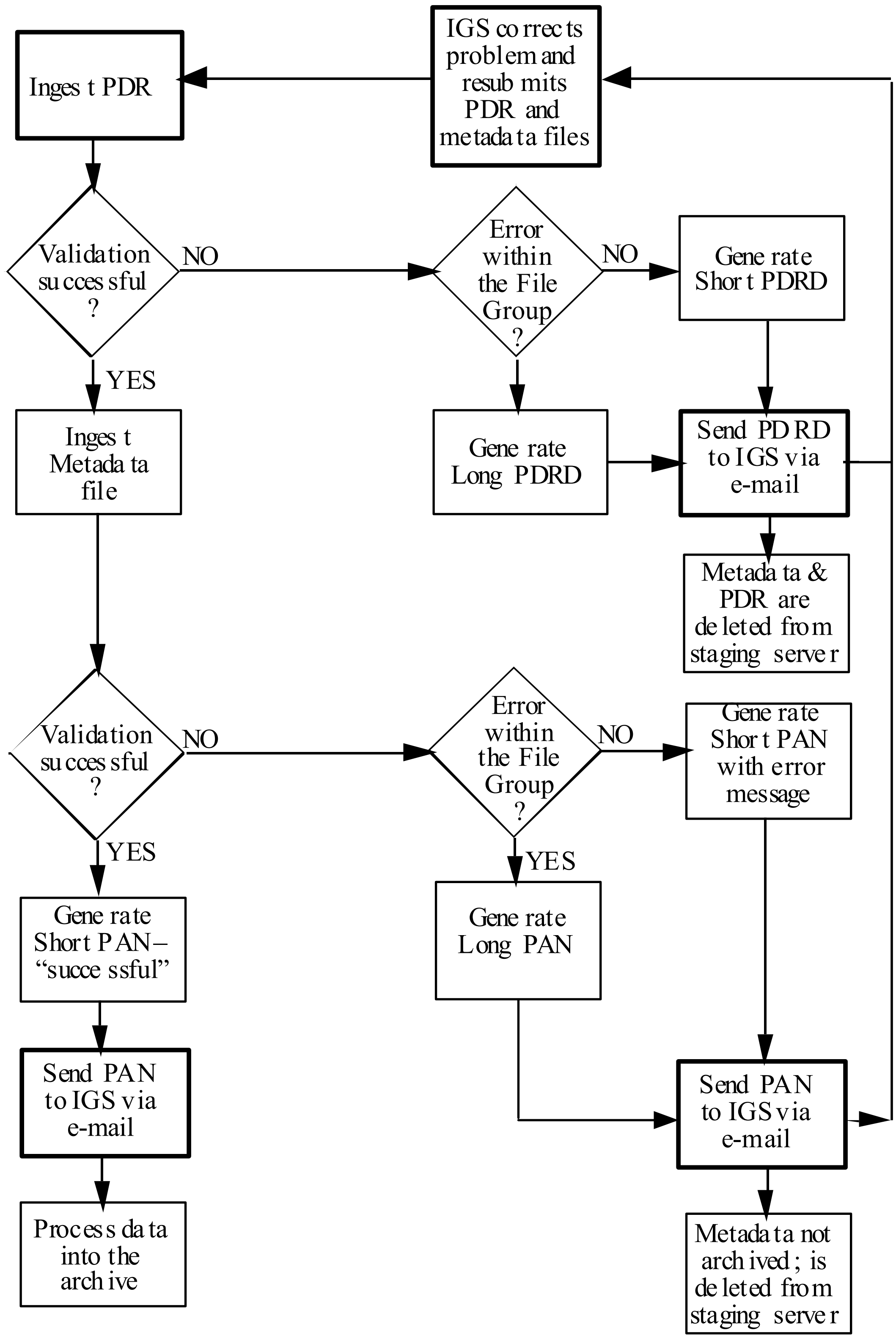


Figure F-2 Electronic Transfer Process.

```
The directory structure on the staging server for metadata files is:

     /IGS/META/xxx/DATA


The directory structure on the staging server for PDR files is:

     /IGS/META/xxx/PDR


where:    xxx = 3-letter station ID from Table H-1

     examples: /IGS/META/CUB/DATA
               /IGS/META/RSA/PDR
```

Figure F-3 Directory Structure on the DAAC Staging Server.

F.1.1 Product Delivery Record File

The purpose of the IGS Product Delivery Record (PDR) is to announce the availability of metadata for transfer, including file names, file size, location, etc. The PDR file format is given in Table F-1. An example of a PDR is shown in Figure F-4. Indentation in the example is for readability only; it is not required formatting.

The IGS PDR file naming convention is:

ORIGINATING_SYSTEM.yyyymmddhhmmss.PDR

where: ORIGINATING_SYSTEM. = value of originating system provided in PDR (IGSxxx where xxx is a 3-letter station id, as defined in Table H-1)
yyyymmdd = date of PDR file creation
hhmmss = time of PDR file creation
.PDR = constant, file extension which identifies this as a PDR file

for example: IGSKUJ.19991127221345.PDR

Each IGS PDR corresponds to a single subinterval and contains a single file group (identified by the parameter OBJECT = FILE_GROUP). The file group in an IGS PDR contains one file.

IGS PDRs are validated to check that all required fields contain valid values and that the format is correct and consistent with the standards. IGS PDRs that adhere to the defined message standards shown in Table F-1 are accepted and processed.

PARAMETER NAME	SIZE (ASCII BYTE)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
ORIGINATING_SYSTEM	6	=IGSxxx; where xxx = 3-letter station identifier as listed in Table H-1; use upper-case letters	Identifies originating station
TOTAL_FILE_COUNT	1	=1;	Total number of metadata files referenced by PDR
OBJECT	10	=FILE_GROUP;	Start of file group parameters
DATA_TYPE	8	=L7IGS;	Identifies this as Landsat 7 IGS metadata
NODE_NAME	7	=xxxxxxx; where xxxxxxx is identified in the Operations Agreement (Reference Document 7)	Identifies server where metadata file resides
OBJECT	9	=FILE_SPEC;	Start of file specific parameters
DIRECTORY_ID	18	=/IGS/META/xxx/DATA; where: xxx = 3-letter station identifier as listed in Table H-1; use upper-case letters	Identifies directory in which metadata file resides
FILE_ID	24	=L7xxxppprrryyyymmddf.MTA; where: "L7" = constant (Landsat 7) xxx = station id code (ref. Table H-1) ppp = WRS Path of first scene rrr = WRS Row of first scene yyyy = 4-digit Year of acquisition mm = Month (01-12) dd = Day (01-31) f = format in file (= 0 for both) ".MTA" = constant (metadata file)	File name - should match the file name in the ./DATA directory
FILE_TYPE	8	=METADATA0;	Identifies the data type in the file and that both formats (0) are included
FILE_SIZE	10	= 0 - 9999999999; (formatted as unsigned 32-bit integer)	Number of bytes in the MTA file; must be <2 GB
END_OBJECT	9	=FILE_SPEC;	End of file parameters
END_OBJECT	10	=FILE_GROUP;	End of file group

Table F-1 Product Delivery Record (PDR) File Format.

```
ORIGINATING_SYSTEM = IGSKUJ;
TOTAL_FILE_COUNT = 1;
OBJECT = FILE_GROUP;
        DATA_TYPE = L7IGS;
        NODE_NAME = (server_name);
        OBJECT = FILE_SPEC;
                DIRECTORY_ID = /IGS/META/KUJ/DATA;
                FILE_ID = L7KUJ110035199911270.MTA;
                FILE_TYPE = METADATA0;
                FILE_SIZE = 11000;
        END_OBJECT = FILE_SPEC;
END_OBJECT = FILE_GROUP;
```

Figure F-4 Example of Product Delivery Record (PDR) File.

F.1.2 Product Delivery Record Discrepancy File

The Product Delivery Record Discrepancy file is sent by the DAAC to the IGS only in the event that the PDR cannot be validated. An IGS PDR specifies only one file group, which contains one file spec. Processing of the file group in an IGS PDR ceases when the first error in that file group is found. There may be further errors in the file group, but only this first error is reported. The PDR Discrepancy file identifies the error or problem that was found.

There are two forms of PDR Discrepancy files: a short form and a long form. The short form is used for PDRs with errors that are not attributable to specific file groups, such as transfer errors. The long form is used when the file group in the PDR has invalid parameters. The short form is specified in Table F-2; the long form is specified in Table F-3. An example of each is shown in Figure F-5.

The IGS PDR Discrepancy file naming convention is:

ORIGINATING_SYSTEM.yyyymmddhhmmss.PDRD

where: ORIGINATING_SYSTEM. = value of originating system provided in PDR (IGSxxx where xxx is a 3-letter station id, as defined in Table H-1)
yyyymmdd = date of creation of associated PDR file
hhmmss = time of creation of associated PDR file
.PDRD = constant, file extension which identifies this as a PDR Discrepancy file (DAAC nomenclature)

for example: IGSKUJ.19991127221345.PDRD

The file name of the PDR Discrepancy file is placed in the subject line of the e-mail message. The body of the e-mail message contains the parameters and values in Tables F-2 or F-3.

The Operations Agreement (Reference Document 7) explains the actions to be taken by the IGS in response to each disposition reported in the PDR Discrepancy file.

PARAMETER NAME	SIZE (ASCII BYTE)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
MESSAGE_TYPE	9	= SHORTPDRD;	Identifies this as a Short PDR Discrepancy file
DISPOSITION	up to 64	= one of the following: "INVALID FILE COUNT"; "ECS INTERNAL ERROR"; "DATABASE FAILURES"; "MISSING OR INVALID ORIGINATING_SYSTEM PARAMETER"; "DATA PROVIDER REQUEST THRESHOLD EXCEEDED"; "DATA PROVIDER VOLUME THRESHOLD EXCEEDED"; "SYSTEM REQUEST THRESHOLD EXCEEDED"; "SYSTEM VOLUME THRESHOLD EXCEEDED";	The discrepancy that was found in the PDR file. Only the first error encountered is given.

Table F-2 Short Product Delivery Record Discrepancy File Format.

PARAMETER NAME	SIZE (ASCII BYTE)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
MESSAGE_TYPE	8	= LONGPDRD;	Identifies this as a Long PDR Discrepancy file
NO_FILE_GRPS	1	= 1;	Number of file groups to follow
DATA_TYPE	8	= L7IGS;	Data type from PDR.
DISPOSITION	up to 64	= one of the following: "INVALID DATA TYPE"; "INVALID DIRECTORY"; "INVALID FILE SIZE"; "INVALID FILE ID"; "INVALID NODE NAME"; "INVALID FILE TYPE";	The discrepancy that was found in the PDR file. Only the first error encountered is given. All checks except file size are for null strings. File size is checked for null string, <0, =0, and ≥2GB.

Table F-3 Long Product Delivery Record Discrepancy File Format.

```
MESSAGE_TYPE = SHORTPDRD;
DISPOSITION = "INVALID FILE COUNT";
```

```
MESSAGE_TYPE = LONGPDRD;
NO_FILE_GRPS = 1;
DATA_TYPE  = L7IGS;
DISPOSITION = "INVALID FILE SIZE";
```

Figure F-5   Example of Short and Long Product Delivery Record (PDR) Discrepancy Files.

F.1.3 Production Acceptance Notification File

The Production Acceptance Notification (PAN) file announces the completion of data transfer and archival of the metadata file, and identifies any errors or problems that were encountered. The IGS PDR specifies a single file group; there will be one file processed within the file group. Only the first error in the file is reported.

There are two forms of PAN files: a short form and a long form. The short form is sent to acknowledge that the metadata file has been successfully transferred, or to report errors which are not specific to the file but which have precluded processing of the file. If an error was found in the file, a long form PAN is sent. The short form is specified in Table F-4; the long form is specified in Table F-5. An example of each is shown in Figure F-6.

The IGS PAN file naming convention is:

ORIGINATING_SYSTEM.yyyymmddhhmmss.PAN

where:	ORIGINATING_SYSTEM.	= value of originating system provided in PDR (IGSxxx where xxx is a 3-letter station id, as defined in Table H-1)
	yyyymmdd	= date of creation of associated PDR file
	hhmmss	= time of creation of associated PDR file
	.PAN	= constant, file extension which identifies this as a PAN file

for example: IGSKUJ.19991127221345.PAN

The file name of the PAN file is placed in the subject line of the e-mail message. The body of the e-mail message contains the parameters and values in Table F-4 or F-5.

The Operations Agreement (Reference Document 7) explains the actions to be taken by the IGS in response to each reported disposition in the PAN file.

PARAMETER NAME	SIZE (ASCII BYTE)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
MESSAGE_TYPE	8	= SHORTPAN;	Identifies this as a Short PAN file
DISPOSITION	up to 64	= one of the following: "SUCCESSFUL"; [Note 1] "NETWORK FAILURE"; [Note 2] "UNABLE TO ESTABLISH FTP/KFTP CONNECTION"; [Note 2] "ALL FILE GROUPS/FILES NOT FOUND"; [Note 2] "FTP/KFTP FAILURE"; [Note 2] "POST-TRANSFER FILE SIZE CHECK FAILURE"; [Note 2] "FTP/KFTP COMMAND FAILURE"; [Note 2] "DUPLICATE FILE NAME IN GRANULE"; [Note 2] "METADATA PREPROCESSING ERROR"; [Note 1] "RESOURCE ALLOCATION FAILURE"; [Note 2] "ECS INTERNAL ERROR"; [Note 3] "INCORRECT NUMBER OF METADATA FILES"; [Note 1] "INCORRECT NUMBER OF FILES"; [Note 1] "DATA CONVERSION FAILURE"; [Note 1] "REQUEST CANCELLED"; [Note 3] "INVALID OR MISSING FILE TYPE"; [Note 1] "FILE I/O ERROR"; [Note 1] "DATA ARCHIVE ERROR"; [Note 1]	The disposition of processing the metadata file. Only the first error encountered is given.
TIME_STAMP	20	= yyyy-mm-ddThh:mm:ssZ; where: yyyy-mm-dd = date "T" = literal indicating start of time field hh:mm:ss = time "Z" = literal indicating Zulu time or = 20 blank spaces (20 Hex)	GMT (Zulu) time when DAAC system completed transfer of all files. See DISPOSITION notes 1-3 to determine when time is present or when field is blank-filled.

Note 1. Dispositions for which there will always be a time stamp.
Note 2. Dispositions for which the time stamp will always be 20 ASCII spaces.
Note 3. Dispositions for which the time stamp is sometimes 20 ASCII spaces, such as when the file has not yet been FTP'd.

Table F-4 Short Production Acceptance Notification (PAN) File Format.

PARAMETER NAME	SIZE (ASCII BYTES)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
MESSAGE_TYPE	7	= LONGPAN;	Identifies this as a Long PAN file
NO_OF_FILES	1	= 1;	Number of files in the PDR
FILE_DIRECTORY	18	= /IGS/META/xxx/DATA; where xxx is the 3-letter station ID as specified in Table H-1	DIRECTORY_ID parameter from the PDR
FILE_NAME	24	=L7xxxppprrryyyymmddf.MTA; where: "L7" = constant (Landsat 7) xxx = station id code (ref. Table H-1) ppp = WRS Path of first scene rrr = WRS Row of first scene yyyy = 4-digit Year of acquisition mm = Month (01-12) dd = Day (01-31) f = format in file (= 0 for both) ".MTA" = constant (metadata file)	FILE_ID parameter from the PDR
DISPOSITION	up to 64	= one of the following: "SUCCESSFUL"; [Note 1] "NETWORK FAILURE"; [Note 2] "UNABLE TO ESTABLISH FTP/KFTP CONNECTION"; [Note 2] "ALL FILE GROUPS/FILES NOT FOUND"; [Note 2] "FTP/KFTP FAILURE"; [Note 2] "POST-TRANSFER FILE SIZE CHECK FAILURE"; [Note 2] "FTP/KFTP COMMAND FAILURE"; [Note 2] "DUPLICATE FILE NAME IN GRANULE"; [Note 2] "METADATA PREPROCESSING ERROR"; [Note 1] "RESOURCE ALLOCATION FAILURE"; [Note 2] "ECS INTERNAL ERROR"; [Note 3] "INCORRECT NUMBER OF METADATA FILES"; [Note 1] "INCORRECT NUMBER OF FILES"; [Note 1] "DATA CONVERSION FAILURE"; [Note 1] "REQUEST CANCELLED"; [Note 3] "INVALID OR MISSING FILE TYPE"; [Note 1] "FILE I/O ERROR"; [Note 1] "DATA ARCHIVE ERROR"; [Note 1]	The disposition of processing the metadata file. Only the first error encountered is given.
TIME_STAMP	20	= yyyy-mm-ddThh:mm:ssZ; where: yyyy-mm-dd = date "T" = literal indicating start of time field hh:mm:ss = time "Z" = literal indicating Zulu time or = 20 blank spaces (20 Hex)	GMT (Zulu) time when DAAC system completed transfer of all files. See DISPOSITION notes 1-3 to determine when time is present or when field is blank-filled.

Note 1. Dispositions for which there will always be a time stamp.
Note 2. Dispositions for which the time stamp will always be 20 ASCII spaces.
Note 3. Dispositions for which the time stamp is sometimes 20 ASCII spaces, such as when the file has not yet been FTP'd.

Table F-5 Long Production Acceptance Notification (PAN) File Format.

```
MESSAGE_TYPE = SHORTPAN;
DISPOSITION = "INCORRECT NUMBER OF METADATA FILES";
TIME_STAMP = 1999-06-23T09:46:35Z;
```

```
MESSAGE_TYPE = LONGPAN;
NO_OF_FILES = 1;
FILE_DIRECTORY = /IGS/META/KUJ/DATA;
FILE_NAME = L7KUJ110035199911270.MTA;
DISPOSITION = "UNABLE TO ESTABLISH FTP CONNECTION";
TIME_STAMP =                ;
```

Figure F-6 Example of Short and Long Production Acceptance Notification (PAN) Files.

F.1.4 Electronic Transfer Error Handling and Backup Methods

During the course of data exchange via FTP, the following error conditions may arise:

- Failure to establish TCP/IP connection
- Erroneous FTP command
- File not found (listed in the PDR but not found on the disk)
- File not readable due to permissions

Should a problem develop during an FTP file transfer due to any of these error conditions, a number of attempts are made to pull the data. The number of attempts is specified by an operations parameter at the DAAC. In the event that problems cannot be resolved in this number of attempts, the DAAC and the IGS operations personnel have the option to coordinate metadata delivery on physical media. While the use of tape media as a backup is not a requirement, it may be useful during emergencies and is fully supported by the DAAC. If it is used, the metadata is delivered uncompressed.

In the event that tape media are used during emergencies, a separate Physical Media PDR file must be supplied for each tape delivered to the DAAC. The Physical Media PDR must be contained as a file on the tape. In the event that a file check on the tape by the DAAC reveals that the Physical Media PDR is missing or unreadable, IGS operations personnel supply DAAC operations personnel with a copy of the Physical Media PDR via fax transmission. The format and information content for the Physical Media PDR is the same as that specified in Section F.2.1.

F.2 Physical Media Transfer

Metadata files may also be delivered to the LP DAAC on physical media, as an alternative to electronic transfer or as a backup in cases of transfer problems. Currently, the only delivery mechanism for browse data, from the IGSs to the DAAC, is physical media. The corresponding subinterval metadata file must accompany each delivery of browse data.

Figure F-7 summarizes the physical media transfer process. The transfer process is described below and depicted in flow chart format in Figure F-8. The next three sections describe the files that facilitate the transfer, and the last two sections discuss error handling, and type and structure of media. The media type is 8mm tape.

The Physical Media PDR, when processed, serves as a data availability notice for ingesting the IGS data from the tape. There is one Physical Media PDR per tape. The Physical Media PDR is structured such that there is one file group for each subinterval recorded on the tape. Within each file group, there is a file spec for one metadata file (with Formats 1 and 2 packaged within a single file) and, possibly, up to 37 browse files.

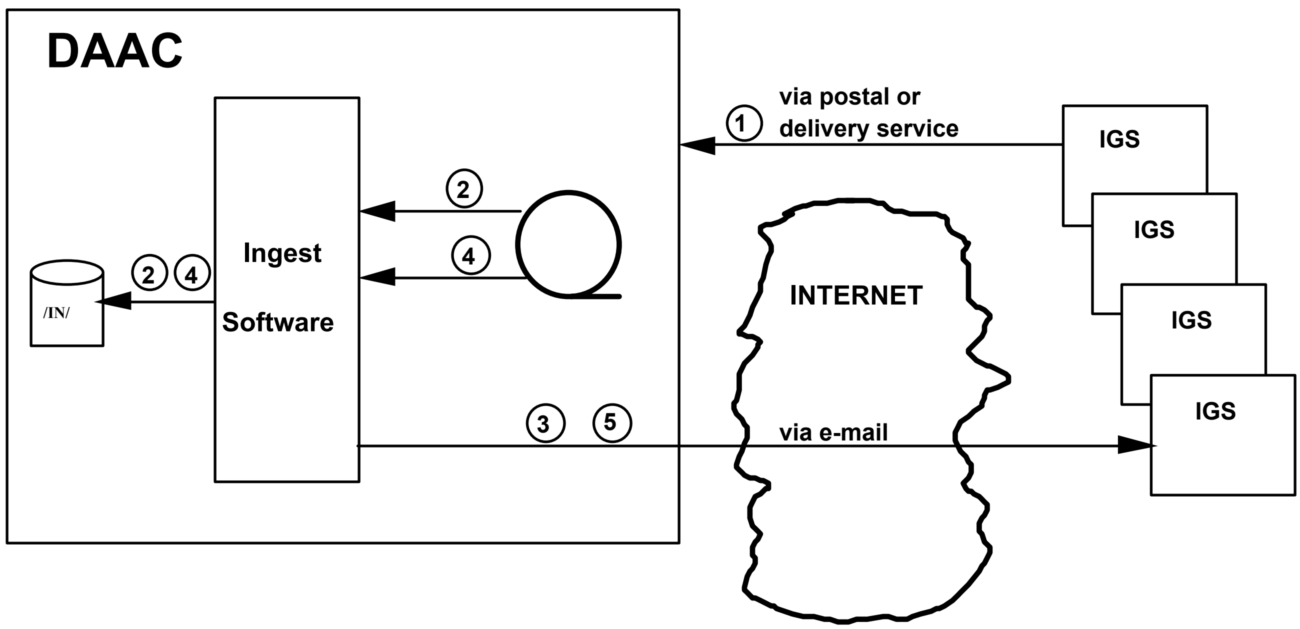
When a Physical Media PDR is ingested from tape, it is validated for proper content and format. If an error is found in the Physical Media PDR, processing is terminated, the associated metadata or browse files are not transferred, and either a short or long Physical Media PDR Discrepancy file is generated and sent to the originating IGS via e-mail. In either case, the original files are deleted from the DAAC system. The IGS corrects the problem reported in the Physical Media PDR Discrepancy file and resubmits the corrected Physical Media PDR and the associated metadata and browse files on physical media to the DAAC. When the Physical Media PDR is successfully transferred and validated, the DAAC does not send anything to the IGS but continues on to the next step of transferring the metadata and browse files for archiving.

The metadata and browse files are checked for conformance with the ODL standards. If no problems are found, the metadata and browse files are ingested into the archive and a short Physical Media PAN file, indicating the status of each file on the tape as successful, is generated and sent via e-mail to the IGS.

If a problem is found during transfer or ingest that affects all of the metadata and browse files on the tape, a short Physical Media PAN file is generated containing a description of the problem and is sent via e-mail to the IGS. Resubmission of the metadata and browse files is done as if it were the original submission – i.e., a Physical Media PDR file and the original set of metadata and browse files (with corrections as indicated by the short Physical Media PAN) are submitted via physical media to the DAAC. All of the previously submitted files (Physical Media PDR, metadata, and browse files) are deleted from the DAAC system.

If a problem is found during ingest or archival that affects some but not all of the metadata and browse files on the tape, a long Physical Media PAN file is generated containing a description of the problem and is sent via e-mail to the IGS. Every file group in which an error has been reported for at least one of its member files must be resubmitted in full, after correction of the reported error(s), as it was in the original submission – i.e., all of the metadata and browse files in each affected file group, and a new Physical Media PDR. All of the original files belonging to the file groups with reported errors are deleted from the DAAC server.

There is a one-to-one correspondence among the Physical Media PDR, the Physical Media PDR Discrepancy (if one is generated), and the Physical Media PAN files.



1. Metadata file(s), browse files, and associated Physical Media Product Delivery Record file are sent to the DAAC from the IGS on physical media via postal or delivery service.

2. The Physical Media Product Delivery Record is processed first.

3. If errors are found in the Physical Media Product Delivery Record, they are reported in the Physical Media PDR Discrepancy file which is sent via e-mail to the IGS.

4. After no errors are found in the Physical Media Product Delivery Record, metadata and browse data are ingested and processed.

5. Results of metadata and browse data processing are reported in the Physical Media Production Acceptance Notification file which is sent to the IGS via e-mail.

Figure F-7 DAAC Architecture and Data Flow for Physical Media Transfer.

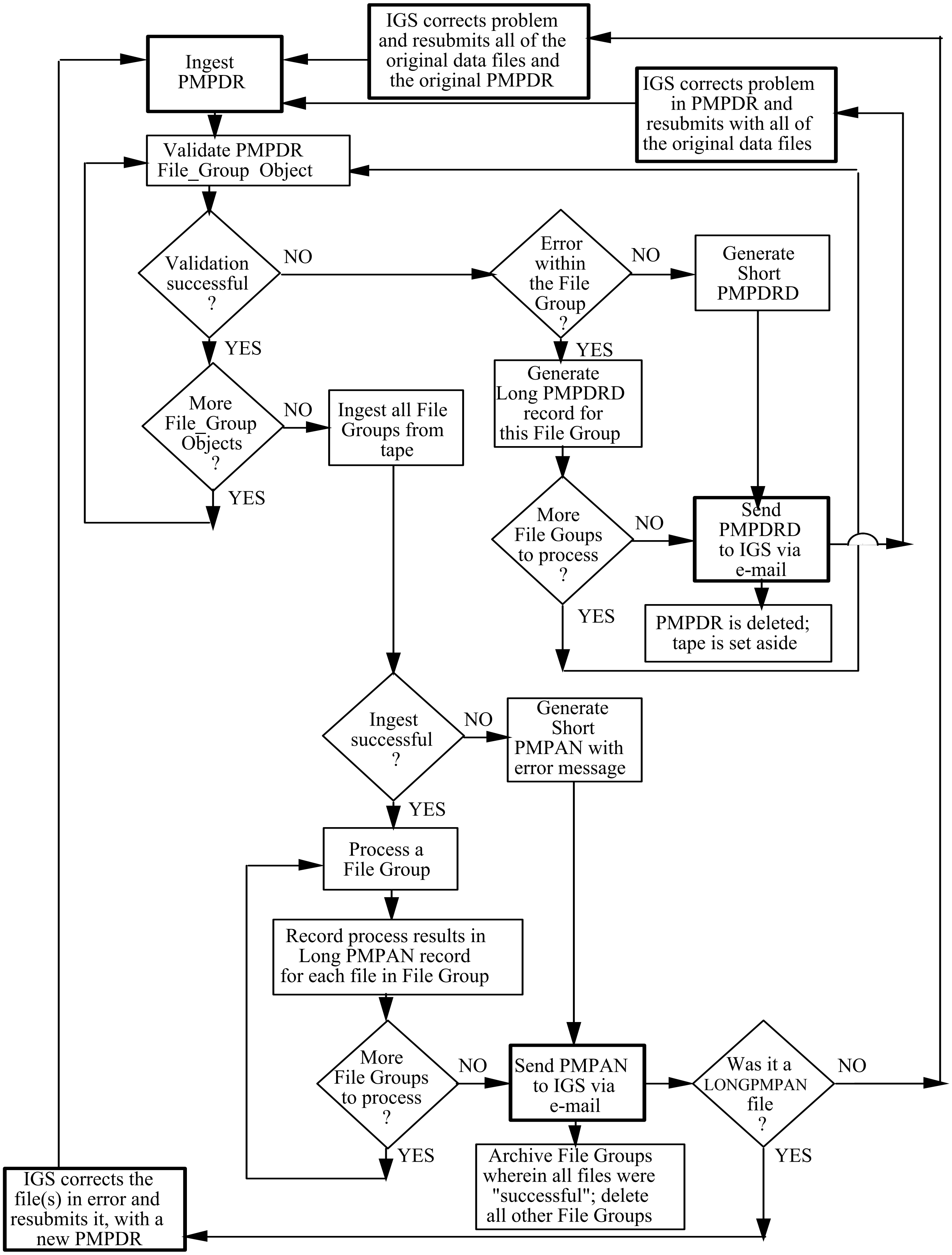


Figure F-8 Physical Media Transfer Process.

F.2.1 Physical Media PDR File

The Physical Media PDR contains information similar to that in the PDR used for electronic transfers. It is specified in Table F-6 and an example is given in Figure F-9. Indentation in the example is for readability only; it is not required formatting.

The IGS Physical Media PDR file naming convention is:

ORIGINATING_SYSTEM.yyyymmddhhmmss.PMPDR

where: ORIGINATING_SYSTEM. = value of originating system provided in Physical Media PDR (IGSxxx where xxx is a 3-letter station id, as defined in Table H-1)
yyyymmdd = date of creation of associated Physical Media PDR file
hhmmss = time of creation of associated Physical Media PDR file
.PMPDR = constant, file extension which identifies this as a Physical Media PDR file

for example: IGSKUJ.19991127221345.PMPDR

The IGS Physical Media PDR contains a file group (identified by the parameter OBJECT = FILE_GROUP) for each subinterval on the tape. In the case of media transfers, there will probably be many subintervals on one tape and therefore many file groups per IGS Physical Media PDR. Within each file group (subinterval), there is a file spec (identified by the parameter OBJECT = FILE_SPEC) for each file. For metadata-only submissions, this will be one file, with Formats 1 and 2 packaged within a single file. For browse submissions, this will be one metadata file and up to 37 browse files per subinterval.

The Physical Media PDR is validated to check that all required fields contain valid values and that the format is correct and consistent with the standards. Physical Media PDRs that adhere to the defined message standards shown in Table F-6 are accepted and processed.

PARAMETER NAME	SIZE (ASCII BYTE)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
ORIGINATING_SYSTEM	6	=IGSxxx; where: xxx = 3-letter station identifier as listed in Table H-1; use upper-case letters	Identifies originating station
TOTAL_FILE_COUNT	1-4	= 1 - 9999;	Total number of files on the tape not including the PMPDR
OBJECT	10	=FILE_GROUP;	Start of file group parameters
DATA_TYPE	8	=L7IGS;	Identifies this file group as containing Landsat 7 IGS metadata and browse files for a subinterval
OBJECT	9	=FILE_SPEC;	Start of file specific parameters
FILE_ID	23-24	=L7xxxppprrryyyymmddf.MTA; or =L7xxxppprrryyyymmdd.Rnn; where: "L7" = constant (Landsat 7) xxx = station id code in upper-case letters (ref. Table H-1) ppp = WRS Path of first scene rrr = WRS Row of first scene yyyy = 4-digit Year of acquisition mm = Month (01-12) dd = Day (01-31) f = format in file (= 0 for both) (applies to metadata filename only) ".MTA" = constant (metadata file) ".R" = constant (browse file) nn = sequence number of the scene in the subinterval for the browse file	File name - should match the file name specified in the metadata
FILE_TYPE	6-9	=METADATA0; or =BROWSE;	Identifies the data type in the file; must be consistent with FILE_ID above
FILE_SIZE	10	= 0 - 9999999999; (formatted as unsigned 32-bit integer)	Number of bytes in this file; must be <2 GB
END_OBJECT	9	=FILE_SPEC;	End of file parameters
The previous five parameters (OBJECT=FILE_SPEC, FILE_ID, FILE_TYPE, FILE_SIZE, END_OBJECT=FILE_SPEC) are repeated for each file associated with the current subinterval (FILE_GROUP).			
END_OBJECT	10	=FILE_GROUP;	End of file group

The previous seven parameters (OBJECT=FILE_GROUP, the five parameters defining the file spec, and END_OBJECT=FILE_GROUP) are repeated for each subinterval on the tape.

Table F-6 Physical Media Product Delivery Record File Format.

```
ORIGINATING_SYSTEM = IGSKUJ;
TOTAL_FILE_COUNT = 5;
OBJECT = FILE_GROUP;
        DATA_TYPE = L7IGS;
                OBJECT = FILE_SPEC;
                        FILE_ID = L7KUJ110035199911270.MTA;
                        FILE_TYPE = METADATA0;
                        FILE_SIZE = 11000;
                END_OBJECT = FILE_SPEC;
                OBJECT = FILE_SPEC;
                        FILE_ID = L7KUJ11003519991127.R01;
                        FILE_TYPE = BROWSE;
                        FILE_SIZE = 100000;
                END_OBJECT = FILE_SPEC;
END_OBJECT = FILE_GROUP;
OBJECT = FILE_GROUP;
        DATA_TYPE = L7IGS;
                OBJECT = FILE_SPEC;
                        FILE_ID = L7KUJ112035199911300.MTA;
                        FILE_TYPE = METADATA0;
                        FILE_SIZE = 11000;
                END_OBJECT = FILE_SPEC;
                OBJECT = FILE_SPEC;
                        FILE_ID = L7KUJ11203519991130.R01;
                        FILE_TYPE = BROWSE;
                        FILE_SIZE = 100000;
                END_OBJECT = FILE_SPEC;
                OBJECT = FILE_SPEC;
                        FILE_ID = L7KUJ11203519991130.R02;
                        FILE_TYPE = BROWSE;
                        FILE_SIZE = 100000;
                END_OBJECT = FILE_SPEC;
END_OBJECT = FILE_GROUP;
```

(This example illustrates one tape containing two subintervals. The first subinterval has one scene, the second subinterval has 2 scenes.)

Figure F-9 Example of Physical Media Product Delivery Record (PDR) File.

F.2.2 Physical Media PDR Discrepancy File

The Physical Media PDR Discrepancy file is sent by the DAAC to the IGS only in the event that the Physical Media PDR cannot be validated. The Physical Media PDR specifies multiple file groups, which may each contain multiple file specs. Processing of a file group in a Physical Media PDR ceases when the first error in that file group is found. There may be further errors in the same file group but only this first error is reported. The PDR Discrepancy file identifies the disposition of each file group - either successful or which errors or problems were found.

There are two forms of Physical Media PDR Discrepancy files: a short form and a long form. The short form is used for PDRs with errors that are not attributable to specific file groups, such as transfer errors. Otherwise, the long form is used. The short form is specified in Table F-7; the long form is specified in Table F-8. An example of each is shown in Figure F-10.

The IGS Physical Media PDR Discrepancy file naming convention is:

ORIGINATING_SYSTEM.yyyymmddhhmmss.PDRD

where: ORIGINATING_SYSTEM. = value of originating system provided in Physical Media PDR (IGSxxx where xxx is a 3-letter station id, as defined in Table H-1)
yyyymmdd = date of creation of associated Physical Media PDR file
hhmmss = time of creation of associated Physical Media PDR file
.PDRD = constant, file extension which identifies this as a Physical Media PDR Discrepancy file (DAAC nomenclature)

for example: IGSKUJ.19991127221345.PDRD

The file name of the Physical Media PDR Discrepancy file is placed in the subject line of the e-mail message. The body of the e-mail message contains the parameters and values in Table F-7 or F-8.

The Operations Agreement (Reference Document 7) explains the actions to be taken by the IGS in response to each reported disposition in the Physical Media PDR Discrepancy file.

PARAMETER NAME	SIZE (ASCII BYTE)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
MESSAGE_TYPE	11	= SHORTPMPDRD;	Identifies this as a Short Physical Media PDR Discrepancy file
DISPOSITION	up to 64	= one of the following: "INVALID FILE COUNT"; "ECS INTERNAL ERROR"; "DATABASE FAILURES"; "MISSING OR INVALID ORIGINATING_SYSTEM PARAMETER"; "DATA PROVIDER REQUEST THRESHOLD EXCEEDED"; "DATA PROVIDER VOLUME THRESHOLD EXCEEDED"; "SYSTEM REQUEST THRESHOLD EXCEEDED"; "SYSTEM VOLUME THRESHOLD EXCEEDED";	The discrepancy that was found in the Physical Media PDR file. Only the first error encountered is given.

Table F-7 Short Physical Media PDR Discrepancy File Format.

PARAMETER NAME	SIZE (ASCII BYTE)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
MESSAGE_TYPE	10	= LONGPMPDRD;	Identifies this as a Long Physical Media PDR Discrepancy file
NO_FILE_GRPS	1-4	= 1-9999	Number of file groups to follow
DATA_TYPE	8	= L7IGS;	Data type from Physical Media PDR.
DISPOSITION	up to 64	= one of the following: "SUCCESSFUL"; "INVALID DATA TYPE"; "INVALID DIRECTORY"; "INVALID FILE SIZE"; "INVALID FILE ID"; "INVALID NODE NAME"; "INVALID FILE TYPE";	The successful disposition or the discrepancy that was found in the Physical Media PDR file. Only the first error encountered is given. All checks except file size are for null strings. File size is checked for null string, <0, =0, and ≥2GB.
The last two parameters (DATA_TYPE and DISPOSITION) are repeated for each file group in the Physical Media PDR.			

Table F-8 Long Physical Media PDR Discrepancy File Format.

```
MESSAGE_TYPE = SHORTPMPDRD;
DISPOSITION = "INVALID FILE COUNT";
```

```
MESSAGE_TYPE = LONGPMPDRD;
NO_FILE_GRPS = 2;
DATA_TYPE  = L7IGS;
DISPOSITION = "INVALID FILE SIZE";
DATA_TYPE  = L7IGS;
DISPOSITION = "SUCCESSFUL";
```

Figure F-10 Example of Short and Long Physical Media PDR Discrepancy Files.

F.2.3 Physical Media PAN File

The Physical Media PAN file announces the completion of data ingest and archival of the metadata and browse files from tape, and identifies any errors or problems that were encountered. The Physical Media PDR specifies multiple file groups, which may contain multiple file specs. All files are checked and reported on, regardless of the number of files found with errors or the number of errors found in each file. However, only the first error in each file is reported.

There are two forms of the Physical Media PAN files: a short form and a long form. The short form is sent to acknowledge that all files have been successfully transferred, or to report errors which are not specific to individual files but which have precluded processing of any and all files. If errors were found in specific files, a long form Physical Media PAN is sent. The last three fields of the long form are repeated for each file group. The short form is specified in Table F-9; the long form is specified in Table F-10. An example of each is shown in Figure F-11.

The Physical Media PAN file naming convention is:

ORIGINATING_SYSTEM.yyyymmddhhmmss.PAN

where: ORIGINATING_SYSTEM. = value of originating system provided in Physical Media PDR (IGSxxx where xxx is a 3-letter station id, as defined in Table H-1)
yyyymmdd = date of creation of associated Physical Media PDR file
hhmmss = time of creation of associated Physical Media PDR file
.PAN = constant, file extension which identifies this as a Physical Media PAN file

for example: IGSKUJ.19991127221345.PAN

The file name of the Physical Media PAN file is placed in the subject line of the e-mail message. The body of the e-mail message contains the parameters and values in Table F-9 or F-10.

The Operations Agreement (Reference Document 7) explains the actions to be taken by the IGS in response to each reported disposition in the Physical Media PAN file.

PARAMETER NAME	SIZE (ASCII BYTE)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
MESSAGE_TYPE	10	= SHORTPMPAN;	Identifies this as a Short Physical Media PAN file
DISPOSITION	up to 64	= one of the following: "SUCCESSFUL"; [Note 1] "NETWORK FAILURE"; [Note 2] "UNABLE TO ESTABLISH FTP/KFTP CONNECTION"; [Note 2] "ALL FILE GROUPS/FILES NOT FOUND"; [Note 2] "FTP/KFTP FAILURE"; [Note 2] "POST-TRANSFER FILE SIZE CHECK FAILURE"; [Note 2] "FTP/KFTP COMMAND FAILURE"; [Note 2] "DUPLICATE FILE NAME IN GRANULE"; [Note 2] "METADATA PREPROCESSING ERROR"; [Note 1] "RESOURCE ALLOCATION FAILURE"; [Note 2] "ECS INTERNAL ERROR"; [Note 3] "INCORRECT NUMBER OF METADATA FILES"; [Note 1] "INCORRECT NUMBER OF FILES"; [Note 1] "DATA CONVERSION FAILURE"; [Note 1] "REQUEST CANCELLED"; [Note 3] "INVALID OR MISSING FILE TYPE"; [Note 1] "FILE I/O ERROR"; [Note 1] "DATA ARCHIVE ERROR"; [Note 1]	The disposition of processing the files. Only the first error encountered is given.
TIME_STAMP	20	= yyyy-mm-ddThh:mm:ssZ; where: yyyy-mm-dd = date "T" = literal indicating start of time field hh:mm:ss = time "Z" = literal indicating Zulu time or = 20 blank spaces (20 Hex)	GMT (Zulu) time when DAAC system completed transfer of all files. See DISPOSITION notes 1-3 to determine when time is present or when field is blank-filled.

Note 1. Dispositions for which there will always be a time stamp.
Note 2. Dispositions for which the time stamp will always be 20 ASCII spaces.
Note 3. Dispositions for which the time stamp is sometimes 20 ASCII spaces, such as when the file has not yet been FTP'd.

Table F-9 Short Physical Media PAN File Format.

PARAMETER NAME	SIZE (ASCII BYTES)	VALUE, FORMAT, RANGE, AND UNITS	PARAMETER DESCRIPTION / REMARKS
MESSAGE_TYPE	9	= LONGPMPAN;	Identifies this as a Long Physical Media PAN file
NO_OF_FILES	1-4	= 1-9999;	Number of files in the Physical Media PDR
FILE_NAME	23-24	=L7xxxppprrryyyymmddf.MTA; or =L7xxxppprrryyyymmdd.Rnn; where: "L7" = constant (Landsat 7) xxx = station id code (ref. Table H-1) ppp = WRS Path of first scene rrr = WRS Row of first scene yyyy = 4-digit Year of acquisition mm = Month (01-12) dd = Day (01-31) f = format in file (= 0 for both) (applies to metadata file name only) ".MTA" = constant (metadata file) ".R" = constant (browse file) nn = sequence number for the scene in the subinterval for the browse file	FILE_ID parameter from the Physical Media PDR
DISPOSITION	up to 64	= one of the following: "SUCCESSFUL"; [Note 1] "NETWORK FAILURE"; [Note 2] "UNABLE TO ESTABLISH FTP/KFTP CONNECTION"; [Note 2] "ALL FILE GROUPS/FILES NOT FOUND"; [Note 2] "FTP/KFTP FAILURE"; [Note 2] "POST-TRANSFER FILE SIZE CHECK FAILURE"; [Note 2] "FTP/KFTP COMMAND FAILURE"; [Note 2] "DUPLICATE FILE NAME IN GRANULE"; [Note 2] "METADATA PREPROCESSING ERROR"; [Note 1] "RESOURCE ALLOCATION FAILURE"; [Note 2] "ECS INTERNAL ERROR"; [Note 3] "INCORRECT NUMBER OF METADATA FILES"; [Note 1] INCORRECT NUMBER OF FILES"; [Note 1] "DATA CONVERSION FAILURE"; [Note 1] "REQUEST CANCELLED"; [Note 3] INVALID OR MISSING FILE TYPE"; [Note 1] "FILE I/O ERROR"; [Note 1] "DATA ARCHIVE ERROR"; [Note 1]	The disposition of processing the file(s). Only the first error encountered is given.
TIME_STAMP	20	= yyyy-mm-ddThh:mm:ssZ; where: yyyy-mm-dd = date "T" = literal indicating start of time field hh:mm:ss = time "Z" = literal indicating Zulu time or = 20 blank spaces (20 Hex)	GMT (Zulu) time when DAAC system completed transfer of all files. See DISPOSITION notes 1-3 to determine when time is present or when field is blank-filled.
The last three fields (FILE_NAME, DISPOSITION, TIME_STAMP) are repeated for each file on tape.			

Note 1. Dispositions for which there will always be a time stamp.
Note 2. Dispositions for which the time stamp will always be 20 ASCII spaces.
Note 3. Dispositions for which the time stamp is sometimes 20 ASCII spaces, such as when the file has not yet been FTP'd.

Table F-10 Long Physical Media PAN File Format.

```
MESSAGE_TYPE = SHORTPMPAN;
DISPOSITION = "INCORRECT NUMBER OF FILES";
TIME_STAMP = 1999-06-23T09:46:35Z;
```

```
MESSAGE_TYPE = LONGPMPAN;
NO_OF_FILES = 5;
FILE_NAME = L7KUJ110035199911270.MTA;
DISPOSITION = "DUPLICATE FILE NAME IN GRANULE";
TIME_STAMP =                  ;
FILE_NAME = L7KUJ11003519991127.R01;
DISPOSITION = "SUCCESSFUL";
TIME_STAMP = 1999-06-23T09:46:37Z;
FILE_NAME = L7KUJ112035199911300.MTA;
DISPOSITION = "SUCCESSFUL";
TIME_STAMP = 1999-06-23T09:46:38Z;
FILE_NAME = L7KUJ11203519991130.R01;
DISPOSITION = "SUCCESSFUL";
TIME_STAMP = 1999-06-23T09:46:40Z;
FILE_NAME = L7KUJ11203519991130.R02;
DISPOSITION = "INCORRECT NUMBER OF FILES";
TIME_STAMP = 1999-06-23T09:46:41Z;
```

Figure F-11 Example of Short and Long Physical Media PAN Files.

F.2.4 Physical Media Transfer Error Handling

In the event that a file check on the tape by the DAAC reveals that the Physical Media PDR is missing or unreadable, IGS operations personnel supply DAAC operations personnel with a hard copy of the Physical Media PDR via fax transmission.

If the tape cannot be read at all, the Mission Management Office will be notified. In this situation, the DAAC cannot generate a Physical Media PDR Discrepancy file as it needs to read the Physical Media PDR in order to generate the discrepancy file.

F.2.5 Type and Structure of Physical Media

The standard physical media type used for the transfer of data to and from the LP DAAC is 8mm cartridge tape (112 meters, 5 GB standard capacity).

The format of the 8 mm tape is a Unix tar file, with a record blocking factor of 127. The tar tape format is ported. The tape is labeled externally with a paper label listing the names of the files on the tape, in the order they were written to the tape.

The DAAC is compliant with the ANSI and ISO standards for physical and logical file formats for the appropriate physical media. The logical structure for 8 mm tape includes a volume description file containing a list of all files on the tape. This is the Physical Media PDR.

Appendix G File Exchange With The MOC

G.1 Sending Files From MOC To IGS

The communications architecture for electronic file transfer between the MOC and the IGSs is shown in Figure G-1. When the MOC generates files to be sent to the IGSs, these files are placed in an output directory on a server on the closed side of the firewall. In the MOC, the Flight Dynamics Facility Orbit and Mission Aids Transformation System (FORMATS) software manages file transfers across the firewall. The FORMATS software polls the output directory for files waiting to be sent. When an IGS file is sensed, FORMATS transfers the file to the appropriate IGS output directory on the open server. Figure G-2 shows the directory structure on the open server for messages to be sent to the IGSs. The IGSs poll their assigned output directories on the open server and retrieve new files using an FTP "get".

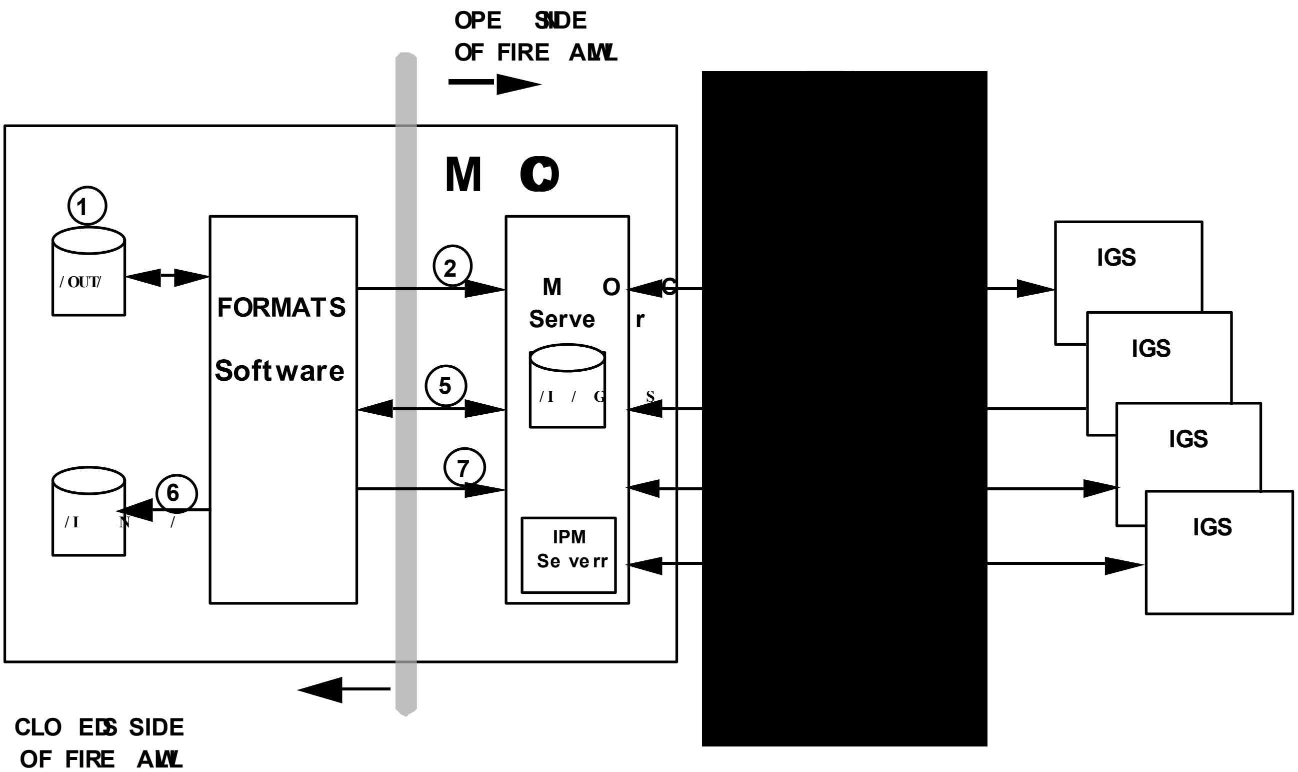
G.2 Sending Files From IGS To MOC

When an IGS generates files to be sent to the MOC, these files are placed in the appropriate input directory on the MOC open server using an FTP "put". Figure G-3 shows the directory structure on the open server for messages received from the IGSs. The FORMATS software polls the input directories on the MOC open server to see if files have been received from an IGS. When a file from an IGS is sensed, FORMATS transfers the file to the appropriate MOC directory on a server on the closed side of the firewall.

G.3 Acknowledging Receipt Of Files From IGS

For all files submitted by the IGSs, except the Priority Mask (PRI) and Priority/Service Request Mask (PSR) files, the FORMATS software generates a Product Report as an acknowledgment to the IGS that the file was received and successfully transferred into the MOC. For Service Request messages, the Product Report also indicates the results of validation. The Product Report is placed in the appropriate IGS output directory on the MOC open server, in accordance with Figure G-2, within 5 minutes of product ingest. Figure G-4 shows an example of a FORMATS Product Report reporting no errors and a FORMATS Product Report reporting one error. The FORMATS Product Report file name consists of the full file name of the input file from the IGS with the letters IRPT, WRPT, or ERPT appended to the extension. Field content validation is performed only on the Service Request message and includes:

- Effective date ≤ Expiration date
- Path = 001 - 233
- Start row = 001 - 248
- Stop row = 001 - 248
- Start Row ≤ Stop Row
- Acquisition Rate = 0 or 1



1 Files (messages) to be sent from the MOC to the IGSs are placed in MOC output directories for pickup by FORMATS.

2 FORMATS polls the MOC output directories for IGS files and places them on the open server in the appropriate IGS output directory.

3 The IGSs poll the open server and "get" the files via FTP.

4 Files to be sent from the IGSs to the MOC are "put" on the open server in the appropriate IGS input directory.

5 FORMATS polls the open server and "gets" files via FTP.

6 Files are validated and transferred to the appropriate MOC server.

7 FORMATS generates Product Reports as acknowledgement of files received from the IGS and transferred into the MOC, or to report errors found during validation of the Service Request message.

8 The IGS uses the IPM online tool to generate the priority map and request map and submit these to the MOC via a client-server interface.

Figure G-1 MOC Communications Architecture and Message Flow.

```
FOR ADM, PRB, REQ, DES, MSK, PRI, PSR MESSAGES

:/LS7/ProductRepository/Inbound/Station/<country>/<sta id>/Products


where:
 <country> = country name from Table H-1, with blanks and commas
removed
 <sta id>  = three-letter station id from Table H-1

examples:
 /LS7/ProductRepository/Inbound/Station/Australia/ASA/Products
  /LS7/ProductRepository/Inbound/Station/Australia/HOA/Products
```

Figure G-2 Directory Structure on the MOC Open Server for Incoming Files.

```
FOR ADM, SCH, BME, IRV, NOR MESSAGES, AND FOR CPF, DEF FILES

/LS7/ProductRepository/Outbound/Station/<country>/<sta id>/Products

FOR FORMATS PRODUCT REPORTS, MANUAL PRIORITY/REQUEST MASK SUBMISSION
REPORTS, IPM LOG REPORT

/LS7/ProductRepository/Outbound/Station/<country>/<sta id>/Reports


where:
 <country> = country name from Table H-1, with blanks and commas
removed
 <sta id>  = three-letter station id from Table H-1

examples:
  /LS7/ProductRepository/Outbound/Station/SaudiArabia/RSA/Products
  /LS7/ProductRepository/Outbound/Station/Brazil/CUB/Reports
```

Figure G-3 Directory Structure on the MOC Open Server for Outgoing Files.

FORMATS Product Report

L71999176HOAREQ.S01xRPT
Date Generated: 1999:176:14:15:46

Product: 309_SVCREQ
Incoming File: L71999176HOAREQ.S01

Message Type	Message
INFO	L71999176HOAREQ.S01 received by Transform.
ERROR	in parsing template cannot open file /home/formats/mmitchel/develop/data/Support/ls7_igsSvcRqst_val.TPL: No such file or directory
ERROR	Unable to parse template /home/formats/mmitchel/develop/data/Support/ls7_igsSvcRqst_val.TPL. 0 syntax errors
ERROR	71999176HOAREQ.S01 data, template or I/O error while validating with ls7_igsSvcRqst_val.TPL
WARN	Could not send event to MOC event log

Error count = 3
Warning count = 1
Total Messages = 5

FORMATS Product Report

L71999176HOAREQ.S01xRPT
Date Generated: 1999:176:14:15:46

Product: 309_SVCREQ
Incoming File: L71999176HOAREQ.S01

Message Type	Message
INFO	L71999176HOAREQ.S01 received by Transform.
INFO	[numReq1] (template line 210 input file line 13 offset 392) : 1 request received
INFO	L71999176HOAREQ.S01 passed validation using ls7_igsSvcRqst_val. TPL.
INFO	L71999176HOAREQ.S01 reformatted OK to L71999176HOAREQ.S01.schRqst using ls7_igsSvcRqst_rfm.TPL
INFO	L71999176HOAREQ.S01 sent to Transmit.

Error count = 0
Warning count = 0
Total Messages = 5

Figure G-4 Sample of FORMATS Product Reports.

The file name convention for the FORMATS Product Report is:

[Original file name]xRPT

where: [Original file name] = the name of the file that was transferred into the MOC and is being acknowledged, including the file extension
x = severity of the message:
- I = informational, no errors are being reported
- W = error(s) is(are) being reported but processing proceeded
- E = error(s) is(are) being reported and processing stopped

RPT = constant, identifies this as a Report file

for example: L71997153DKIREQ.S00IRPT

For the PRI and PSR files, receipt of these files at the MOC is acknowledged by the generation of a Manual Priority/Request Mask Submission Report (see Figure G-5). This report describes the result of the file validation process. If the file failed validation, the reason for the failure is given. If the file was successfully validated, the IGS is informed that the file passed and was submitted to the database. Validation performed on the PRI and PSR files includes: field content validation, comparison to priority constraints established for each station, and existence of validated/submitted priority for each scene being requested.

The file naming convention for the Manual Priority/Request Mask Submission Report is:

L7yyyydddxxxRPT.Snnrrrr

where:
- L7 = constant for Landsat 7
- yyyy = 4-digit year of file creation
- ddd = 3-digit day of year of file creation
- xxx = 3-letter station id as defined in Table H-1
- RPT = identifies this as a Manual Priority/Request Mask Submission Report
- .Snn = sequence number of the file type for this day of creation; e.g., .S01 is the second file sent to the station on that day
- rrrr = validation result:
  - "PASS" for successful validation, (e.g., L72002125BJCRPT.S01PASS)
  - "FAIL" for validation failure, (e.g., L72002125GNCRPT.S00FAIL)

G.4 Directory Maintenance On The Open Server

Each IGS has both read and write privileges in their own directories. The IGSs are responsible for file maintenance and cleanup of the output directory (used by the MOC to send files to the IGSs). There is no need for the IGSs to maintain the input directory, because FORMATS removes the files from the input directory as soon as it processes them. The MOC periodically initiates a file purge on the output directories, to make sure that the directories are not in use as long term storage of files. This purge occurs at approximately 30-day intervals, under operator initiation and control. Advance warning of the purge is given to the IGSs via the ADM message.

Further details on all aspects of file exchange with the MOC are found in the Operations Agreement (Reference Document 7).

```
Manual Priority/Request Mask Submission Report

Station tst
Priorities
Effective Cycle 1
Expiration Cycle 1
Start Path 18
Start Row 41

2002-09-16 16:22:04.615

The map priorities passed validation.
```

```
Manual Priority/Request Mask Submission Report

Station tst
Priorities
Effective Cycle 1
Expiration Cycle 1
Start Path 18
Start Row 41

2002-07-19 10:04:55.952

The map priorities failed validation due to:
    path 4  row 42: Land priority assigned to water scene.
```

```
Manual Priority/Request Mask Submission Report

Station tst
Requests
Effective Cycle 1
Expiration Cycle 1
Start Path 18
Start Row 41

2002-09-16 16:22:06.408

The map requests passed validation.
```

```
Manual Priority/Request Mask Submission Report

Station tst
Requests
Effective Cycle 1
Expiration Cycle 1
Start Path 18
Start Row 41

2002-09-16 16:30:52.835

The map requests failed validation due to:
    path 18  row 46: Request for scene with no priority.
    path 18  row 47: Request for scene with no priority.
```

Figure G-5   Sample of Manual Priority/Request Mask Submission Reports.

Appendix H International Ground Station Names And Locations

The International Ground Stations (IGSs) that may participate in Landsat 7 are listed in Table H-1. For each station, the following information is listed:

- Country – The country which owns the station.
- Location – The city or area in which the station is located.
- Station id – The 3-letter ID that will be used in file names, messages, and reports for this station.
- Interface directly to the MOC? – Indication of whether the receive site interfaces directly with the MOC for acquisition scheduling or through another facility; if another facility is used, it is identified.
- Interface directly to the DAAC? – Indication of whether the receive site interfaces directly with the DAAC for browse/metadata transfer or through another facility; if another facility is used, it is identified.

COUNTRY	LOCATION	STA ID	INTERFACE DIRECTLY WITH MOC?	INTERFACE DIRECTLY W/ DAAC?
Argentina	Cordoba	COA	YES	YES
Australia	Alice Springs	ASA	All through Canberra	NO, through Canberra
Australia	Hobart	HOA	All through Canberra	NO, through Canberra
Brazil	Cuiaba	CUB	YES	YES
Canada	Gatineau	GNC	All through Ottawa	NO, through Ottawa
Canada	Prince Albert	PAC	All through Ottawa	NO, through Ottawa
Ecuador	Cotopaxi	CPE	YES	YES
Egypt	Aswan	AWE	TBD	TBD
Gabon	Libreville	LBG	YES	YES
Germany	Neustrelitz	NSG	REQ through ESRIN	NO, through ESRIN
Hawaii	University of	UHI	YES	YES
Indonesia	Parepare	DKI	YES	YES
Italy	Fucino	FUI	REQ through ESRIN	NO, through ESRIN
Italy	Matera	MTI	REQ through ESRIN	NO, through ESRIN
Japan	Hatoyama	HAJ	All through EOC	YES
Japan	Hiroshima	HIJ	All through EOC	YES
Japan	Kumomoto	KUJ	All through EOC	YES
Korea	Seoul	SEK	TBD	TBD
Malaysia	Kuala Lumpur	KLM	YES	YES
Mongolia	Ulaanbaatar	ULM	REQ through DLR	NO, through DLR
Pakistan	Islamabad	ISP	YES	YES
Peoples Republic of China	Beijing	BJC	YES	YES
Puerto Rico	University of	UPR	YES	YES
Saudi Arabia	Riyadh	RSA	YES	YES
Singapore	Singapore	SGP	YES	YES
South Africa	Johannesburg	JSA	YES	YES
Spain	Maspalomas	MPS	REQ through ESRIN	NO, through ESRIN
Sweden	Kiruna	KIS	REQ through ESRIN	NO, through ESRIN
Taipei, China	Chung-Li	TFT	YES	YES
Taipei, China	Chung-Li	TMT	YES	YES
Thailand	Bangkok	BKT	YES	YES

Table H-1 IGS Site Descriptions.

Appendix I IGS Priority & Request Map Editor (IPM) Online Tool

The IGS Priority & Request Map Editor (IPM) online tool is a web-based tool allowing each IGS to specify: 1) the acquisition priority to be applied to all scenes within the station's acquisition circle; 2) which scenes are being requested for acquisition. The priority and request assignments are made on a 16-day cycle or season (series of cycles) basis. Stations log-on to the IPM on an International Cooperator basis (e.g., Australia) and have access to all stations "owned" by the IC (e.g., ASA, HOA) without having to log-off to enter data for a different station. IPM tool log-in details are given in the Operations Agreement (Reference 7).

The IPM tool provides the following functionality:

- Editing of priorities and requests onto a map
- Saving of priority and request maps
- Validation of priority and request maps
- Submission of priority and request maps to the MOC database
- Copy, paste, and compare functions between maps of the same station
- Geographic and rectangular display modes for maps
- Operations on priorities only, on requests only, or on both simultaneously (not recommended)
- Reports on the status of map submissions
- Logs of IC activities

Use of the IPM online tool is the preferred alternative to submission of the Priority Mask message described in section B.12 and the Service Request message described in section B.3. Another preferred alternative is the ftp of a Priority/Service Request Mask (PSR) file described in section B.13. The PSR can be used to submit either requests or priorities. Figure I-1 shows all of these methods of submission. The reasons that methods 1 (IPM online session) and 2 (PSR file submission) are preferred include:

- The IPM tool has knowledge of priorities and requests defined either by online IPM sessions or by submission of PSR files.
  - If an IGS decides to change their method of submission in the future from PSR to online sessions, the full history of priorities and requests submitted to date will be in the IPM database and available to the IGS.
  - The IGS can use the IPM online tool to see reports of all PSR submissions for the year.
- Validation performed by the IPM includes all requests and priorities submitted by online sessions and by PSR, but not requests or priorities submitted by REQ and PRI messages.
- REQ and PRI validation is primarily on field content (e.g., is that a valid path number?) and not on logical content (e.g., is that a valid priority? does the request have an assigned priority?) so the end results could be less than desirable (e.g., request for a scene with no priority assigned so chances of acquisition are low)

Results from validation during online sessions are available in real-time and results from validation of PSR files are available within 5 minutes. Results from PRI file submission could be delayed by days while manual validation is performed and only field content validation is performed on the REQ files.

Use of the online sessions or the PSR files prevents requests over water, requests for scenes with no assigned priority, and provides automated policing of priority-assignment rules.

Tutorial files (Reference 13) are available to explain the operation of the IPM tool:
- Part A - Working With Priorities
- Part B - Working With Requests
- Part C - Pop-Up Messages
- Part D - Geographic Display Capability
- Part E - Making a Manual Mask Submission

I.1 Entering Priorities

The available priorities to be assigned are high, medium, and low. There are constraints applied to the use of each. These constraints are:
- For each cycle, the IPM shall constrain high-priority scenes to a maximum per day for a given IGS. The default maximum is 10. Alternative maximums may be negotiated on a per station basis.
- For each cycle, the IPM shall constrain medium-priority scenes to a maximum per cycle for a given IGS. The default maximum is 460 minus the number of high priority scenes for the cycle.
- The IPM shall constrain the path span of the high priority scenes to a maximum per single cycle day for a given IGS. The default is 3 paths per cycle day may have high priority scenes specified with them.
- The IPM shall constrain the contiguity of high priority scenes for a given IGS. The default is that high priority scenes within a path must be contiguous. Exceptions to this may be negotiated on a per station basis.

I.2 Entering Requests

Requests can be submitted as often or as seldom as the IGSs are currently submitting them using the REQ file. The primary constraint is that each scene being requested must have an assigned priority already submitted to the MOC for each cycle of the request. For this reason, it is highly recommended that the priorities be assigned, validated, and submitted before work is begun on requests.

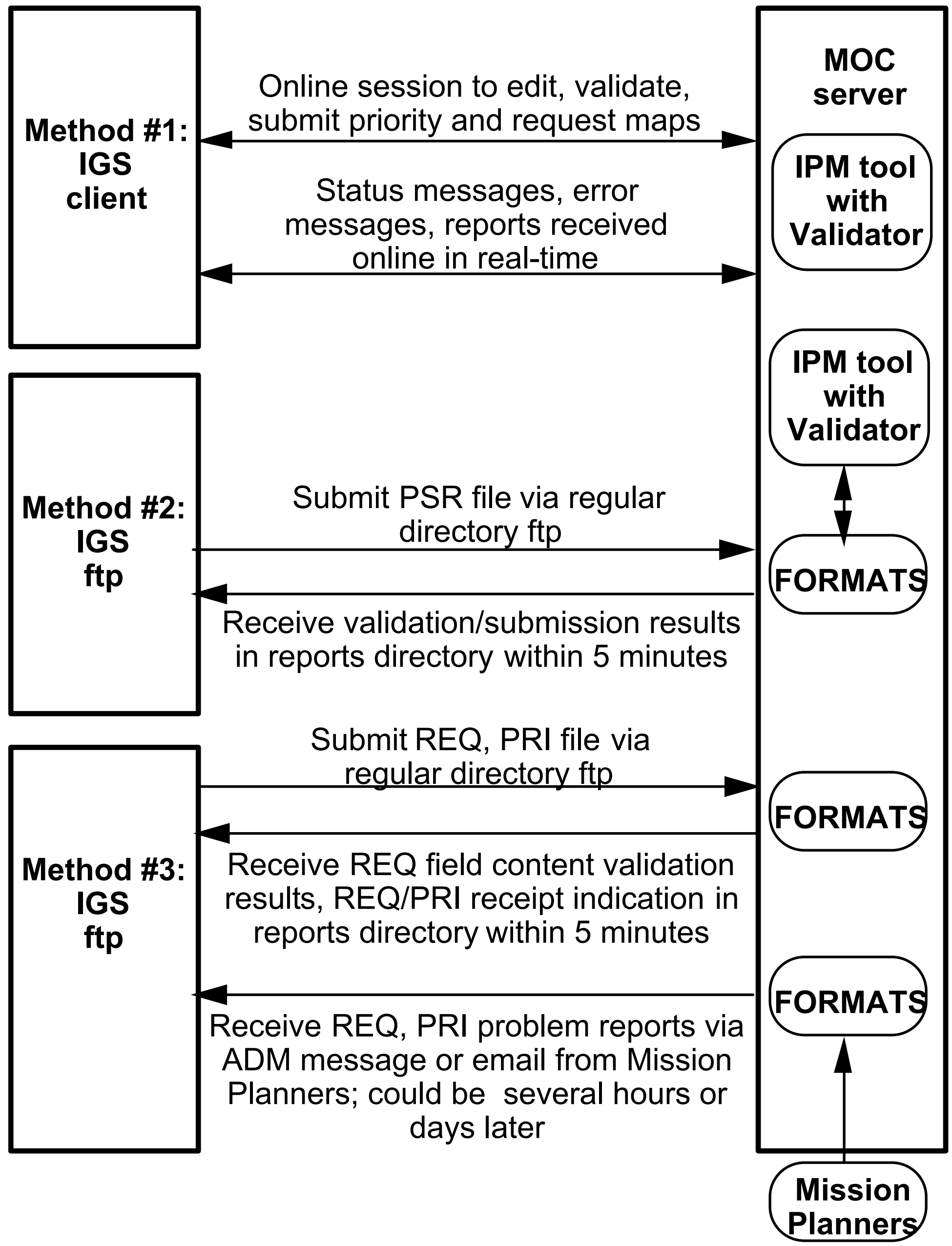


Figure I-1 Data flow showing the three methods of submission of priorities and requests.

References

The following documents are listed for the convenience of the user. These documents do not form a part of this ICD and are not controlled by their reference herein. In the event of a conflict between this ICD and the documents listed, the ICD shall govern.

For each reference, the following information is provided, as applicable:

- Document owner
- Document number
- Document title

If the reference is available online, the web URL is given. Mailing addresses for the owners of these documents are provided at the end of this section.

Reference Document 1
NASA/CCSDS Secretariat. CCSDS 701.0-B-1. Recommendations for Advanced Orbiting Systems, Networks and Data Links.

Reference Document 2
USGS/EDC. 430-11-06-008. Landsat 7 Data Format Control Book (DFCB) Volume I - Data Acquisition Plan.

Available at: http://landsat7.usgs.gov/resource.html

Reference Document 3
USGS/EDC. 23007702-IV. Landsat 7 System Data Format Control Book (DFCB) Volume IV - Wideband Data.

Available at: http://landsat7.usgs.gov/resource.html

Reference Document 4
USGS/EDC. 430-11-06-007. Landsat 7 Data Format Control Book (DFCB) Volume V Book 1 - Level 0R Product Distribution Format.

Available at: http://landsat7.usgs.gov/resource.html

Reference Document 5
JPL. JPL D-7669 Part 2. Planetary Data System Standards Reference, Chapter 12, Object Description Language (ODL) Specification and Usage.

Available at: http://pds.jpl.nasa.gov/stdref/chap12.htm

Reference Document 6
NASA/GSFC. 430-15-01-003. Landsat 7 Science Data Users Handbook.

Rich Irish. Landsat 7 Science Data Users Handbook. NASA/GSFC. <http://ltpwww.gsfc.nasa.gov/IAS/htmls/handbook/handbook_toc.html

Also available via a link from: http://landsat7.usgs.gov/resource.html

Reference Document 7
USGS/EDC. L7-OA-07. Landsat 7 Operations Agreement (OA) between the International Ground Stations (IGSs) and Landsat 7.

Available at: http://landsat7.usgs.gov/igsdocs.html

Reference Document 8
NCSA. Hierarchical Data Format (HDF) User's Guide.

Available at: http://hdf.ncsa.uiuc.edu/doc.html.

Reference Document 9
Aerospace Corporation. Improved Reduced-Resolution Satellite Imagery. 1995. James Ellison and Jaime Milstein.

Available at: http://landsat7.usgs.gov/igsdocs.html

Reference Document 10
A Report on LANDSAT Browse Generation using Wavelets for Image Reduction. September 1994. Peña.

Reference Document 11
USGS/EDC. Landsat 7 Long Term Acquisition Plan (LTAP) for Global Archive Refresh: Global Land Data Base, LTAP Default Gain File, LTAP Nominal Cloud Cover File, LTAP Seasonality File.

Available at: http://landsat7.usgs.gov/acqplan.html

Reference Document 12
USGS/EDC. One year of sun angle files.

Available at: http://landsat7.usgs.gov/igsdocs.html

Reference Document 13
USGS/EDC. IGS Priority & Service Request Mask Editor (IPM) Tutorial Files: Part A - Priorities, Part B - Requests, Part C - Messages, Part D - Geographic Display, Part E - Manual Submission.

Available at: http://landsat7.usgs.gov/igsdocs.html

Addresses for some of the document owners cited above are:

JPL:
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109

NASA/CCSDS Secretariat:
CCSDS Secretariat
Communications and Data Systems Div. (Code–TS)
National Aeronautics and Space Administration
Washington, DC 20546

NASA/GSFC, Rich Irish:
Goddard Space Flight Center
Code 923
Greenbelt, MD 20771

NCSA:
University of Illinois at Urbana-Champaign
National Center for Supercomputing Applications (NCSA)

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